6545

HAZWRAP

HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM

Air Pathway Screening Assessments

for

Resource Conservation and Recovery Act Subpart X Permitting

U.S. Army Environmental Center
May 1995

Revision 0

Unlimited Distribution
Approved for Public Release

prepared by
Halliburton NUS Corporation

HAZWRAP SUPPORT CONTRACTOR OFFICE
Oak Ridge, Tennessee 37831
operated by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

6545

Air Pathway Screening Assessments

for

Resource Conservation and Recovery Act Subpart X Permitting

U.S. Army Environmental Center
May 1995

Revision 0

Unlimited Distribution
Approved for Public Release

Air Pathway
Screening Assessments

for

Resource Conservation and Recovery Act
Subpart X Permitting

U.S. Army Environmental Center
May 1995

Revision 0

Prepared by
Halliburton NUS Corporation

James Teou.
Technical Reviewer

S. Hawley
Editorial Reviewer

NOTICE

The distribution of this document is restricted to use by the U.S. Army. Ms. R. Queen (410-671-1203) of the U.S. Army Environmental Center should be contacted regarding requests for additional distribution.

CONTENTS

APPENDIXES

TABLES

FIGURES

EXECUTIVE SUMMARY

The Army and other Military Services use open burning (OB) and open detonation (OD) for the demilitarization of energetic material items. These units are subject to the permitting requirements of the Resource Conservation and Recovery Act (Subpart X). An air pathway assessment must be provided as a key part of the Subpart X permit application. However, the U.S. Environmental Protection Agency has not issued detailed technical guidance to address the unique air pathway assessment issues for OB/OD units. Therefore, the U.S. Army Environmental Center, in consultation with the U.S. Army Center for Health Promotion and Preventive Medicine, has developed Subpart X permitting guidance for the Army.

The specific objective of this document, therefore, is to provide technical guidance to air quality specialists for the conduct of air pathway screening assessments for OB/OD units. The screening assessments are applicable to OB/OD units with low to moderate treatment quantities (i.e., less than or equal to 1 ton per day and 250 tons per year net explosive weight). This guidance will facilitate a consistent Army-wide approach for the conduct of these air pathway assessments.

The recommended air pathway screening assessment approach involves the following five steps:

- Step 1: Obtain OB/OD unit and waste characterization data
- Step 2: Calculate air emission factors
- Step 3: Identify relevant air criteria
- Step 4: Conduct dispersion modeling
- Step 5: Evaluate air pathway impacts.

Screening results may indicate the need for a refined air pathway assessment. The scope of refined assessments will be a function of many installation-specific factors. Therefore, this guidance does not address refined assessments.

1.0 INTRODUCTION AND BACKGROUND INFORMATION

This document presents guidance on the conduct of air pathway screening assessments to support Army-wide permitting activities for open burning (OB) and open detonation (OD) units.

1.1 SUBPART X PERMITTING NEEDS

The U.S. Environmental Protection Agency (U.S. EPA) on December 10, 1987 promulgated Resource Conservation and Recovery Act (RCRA) rules (Subpart X of 40 CFR 264.600 - 264.603) applicable to hazardous waste "miscellaneous units that require development of environmental performance based standards." "Miscellaneous unit" refers to a hazardous waste management unit (used to treat, store, or dispose of hazardous waste) that does not fit the current definition of container, tank, surface impoundment, pile, land treatment unit, landfill, incinerator, boiler, or industrial furnace with appropriate technical standards under 40 CFR 264; an underground injection well with appropriate technical standards under 40 CFR 146; or a unit eligible for a research, development, and demonstration (RD&D) permit under 40 CFR 270.66. The Military Services and some commercial contractors conduct operations which use OB/OD to demilitarize energetic material items. These OB/OD operations are subject to the requirements of Subpart X. Therefore, Subpart X requirements must be addressed in RCRA Part B permit applications for each installation with active OB/OD operations.

RCRA permitting regulations (40 CFR 270.23) require permit applications for miscellaneous units to contain information on the potential pathways of exposure of human and environmental receptors to hazardous waste or constituents as well as the nature and magnitude of such exposures. RCRA Subpart X permit applications must also contain information demonstrating compliance with other applicable portions of RCRA.

A major permitting factor in addition to RCRA requirements is demonstration of compliance with ambient air quality criteria established by the Clean Air Act (CAA) and with additional ambient air quality and air toxics criteria established by many states, as well as a demonstration that air pathway impacts will not adversely affect human health and the environment. There is also the potential that modifications of the amount of energetic materials treated by OB/OD at an installation might trigger the need for a New Source Review/Prevention of Significant Deterioration (NSR/PSD) permit application based on CAA requirements. In addition, air permits for OB/OD sources may be required by some states. Also, the air toxic provisions and Federal permit provisions of the 1990 Clean Air Act Amendments (CAAA) may require that operating permits be obtained for all OB/OD units in the future, although currently U.S. EPA has not identified OB/OD as a specific activity to be regulated.

The permitting process for Subpart X units is quite often a challenge because of the lack of regulatory guidance to address the many controversial issues (such as the conduct of air pathway screening assessments) associated with OB/OD units. Therefore, there is a need to establish an Army-wide approach for the conduct of air pathway assessments for Subpart X permit applications.

1.2 OBJECTIVE

Subpart X units are of vital importance for the demilitarization of energetic material items. Frequently, viable alternative treatment technologies are not available. The lack of regulatory guidance for the conduct of air pathway assessments for Subpart X units complicates the permitting process. Failure to obtain the necessary Subpart X permits could result in the cessation of OB/OD operations and could jeopardize the missions of many installations that have these units, particularly munition production plants and depots.

The U.S. Army Environmental Center (AEC) has been designated to coordinate the U.S. Army Subpart X permitting effort. This support includes addressing those aspects that have an Army-wide impact and working with other DOD organizations (such as the Ordnance Executive Steering Committee) and regulatory agencies to assist Installation Commanders in obtaining permits for OB/OD operations. A major component of this Subpart X permitting support is the development of a Management Plan (permitting strategy which will be beneficial on an Army-wide basis) and a companion Position Paper (which addresses Subpart X permitting issues and has been adopted by DOD) to ensure a uniform approach for developing permit applications for OB/OD units and responding to Notices of Deficiency (NODs) issued by regulatory agencies. These documents include limited guidance regarding air pathway assessments for Subpart X units. Therefore, supplemental air pathway guidance is necessary to support installation-specific permitting needs.

The specific objective of this document, therefore, is to provide additional technical guidance to air quality specialists for the conduct of air pathway screening assessments for OB and OD units with low to moderate treatment quantities (i.e., less than or equal to 1 ton per day and 250 tons per year net explosive weight) to support Subpart X permit applications. This guidance will facilitate a consistent Army-wide approach for the conduct of these air pathway assessments. Screening assessments are generally based on conservative assumptions and models and can be used to determine if a refined installation-specific assessment (which would require a much greater level of effort) is needed. This screening assessment process is illustrated in Fig. 1.2-1.

The scope of refined assessments will be a function of many installation-specific factors. Therefore, this guidance document does not address refined assessments.

The screening assessment will focus on OB and OD sources which represent the typical Subpart X units at Army installations. Thus, guidance applicable to static firing (SF) to demilitarize missiles is not specifically addressed, but most of the OB/OD air pathway guidance can be easily adapted to SF assessments.

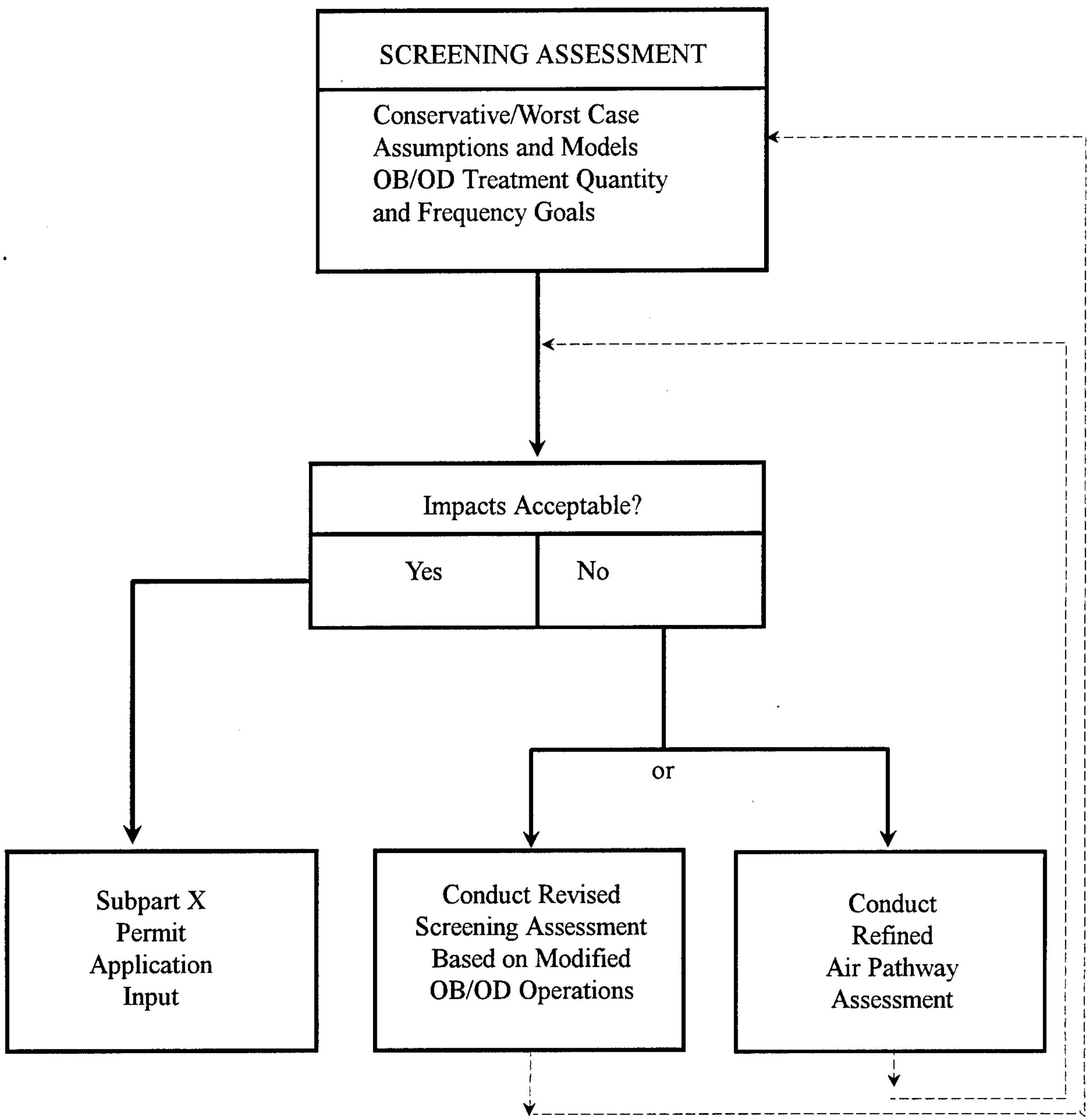


Fig. 1.2-1. Screening assessment process.

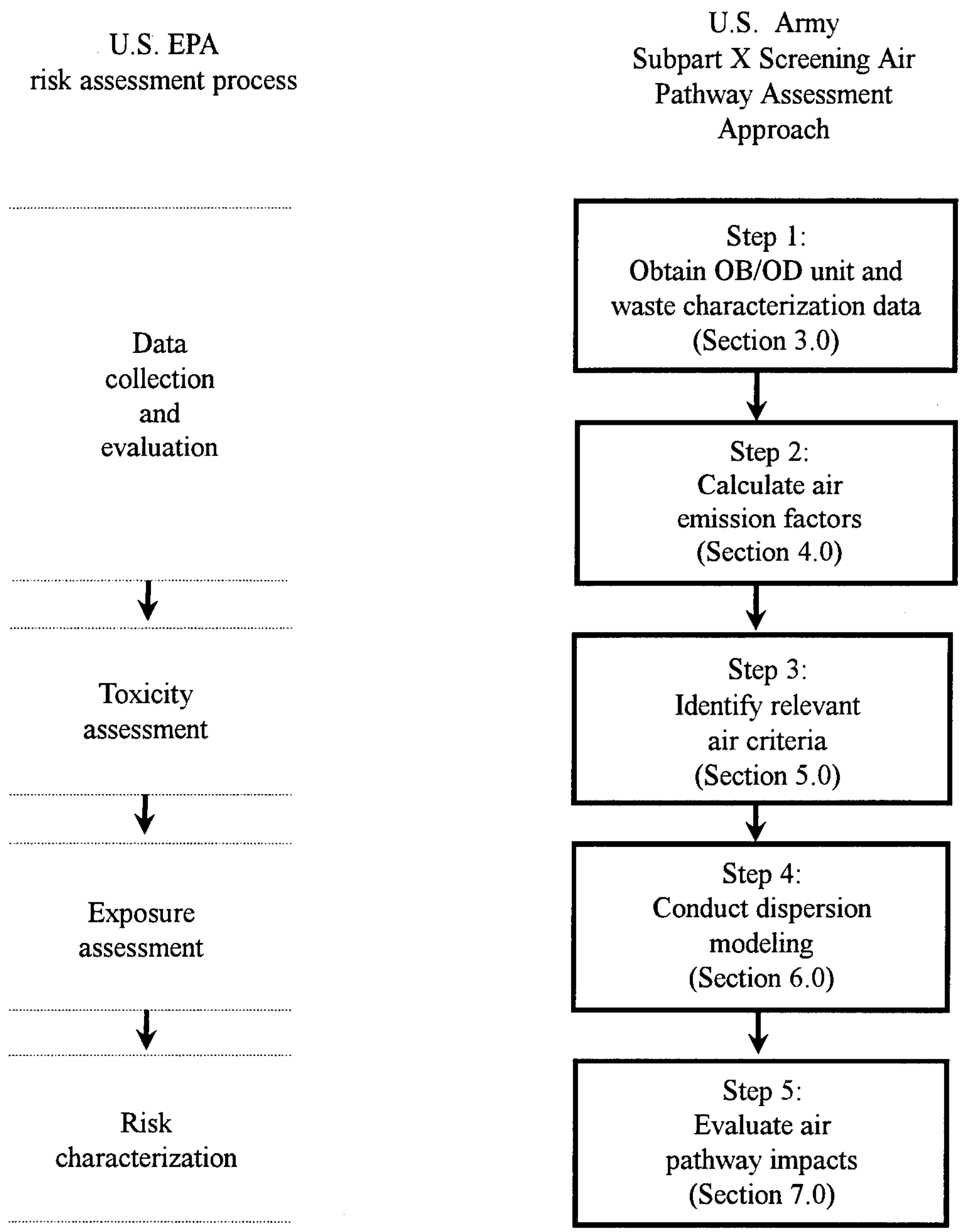


Fig. 2.0-1. U.S. Army Subpart X air pathway screening assessment approach - overview.

2.0 AIR PATHWAY SCREENING ASSESSMENT OVERVIEW

This section presents an overview of a standard recommended approach for the conduct of screening assessments to evaluate air impacts of OB/OD units (with low to moderate treatment quantities) as input for Subpart X permit applications. A screening assessment is conducted based on conservative assumptions and methods/models to characterize air pathway impacts and to determine the need for a refined assessment. Adoption of these air pathway screening procedures will facilitate greater Army-wide consistency regarding Subpart X permitting actions.

The technical procedures described in this document are based on the technical approach used for recent Subpart X permit applications for U.S. Army installations. Some of these applications have been subject to regulatory review, and the air pathway assessment approach has been acceptable. Therefore, regulatory acceptance precedence for use of this approach has been established for Subpart X permitting.

The screening air pathway assessment protocol consists of the following five steps:

- Step 1: Obtain OB/OD unit and waste characterization data
- Step 2: Calculate air emission factors
- Step 3: Identify relevant air criteria
- Step 4: Conduct dispersion modeling
- Step 5: Evaluate air pathway impacts.

These steps can be associated with the following stages of the standard U.S. EPA risk assessment process as illustrated in Fig. 2.0-1 (U.S. EPA, December 1989):

- Data collection and evaluation (Steps 1 and 2)
- Toxicity assessment (Step 3)
- Exposure assessment (Step 4)
- Risk characterization (Step 5)

The five-step screening air pathway assessment protocol is discussed in Sections 3.0 through 7.0. References are listed in Section 8.0.

This document is presented in a format which facilitates future updates.

3.0 STEP 1: OBTAIN OB/OD UNIT AND WASTE CHARACTERIZATION DATA

Step 1 consists of obtaining OB/OD unit and waste characterization data which are critical inputs to the air pathway assessment (refer to Fig. 3.0-1). These steps are discussed in Sections 3.1 and 3.2, respectively.

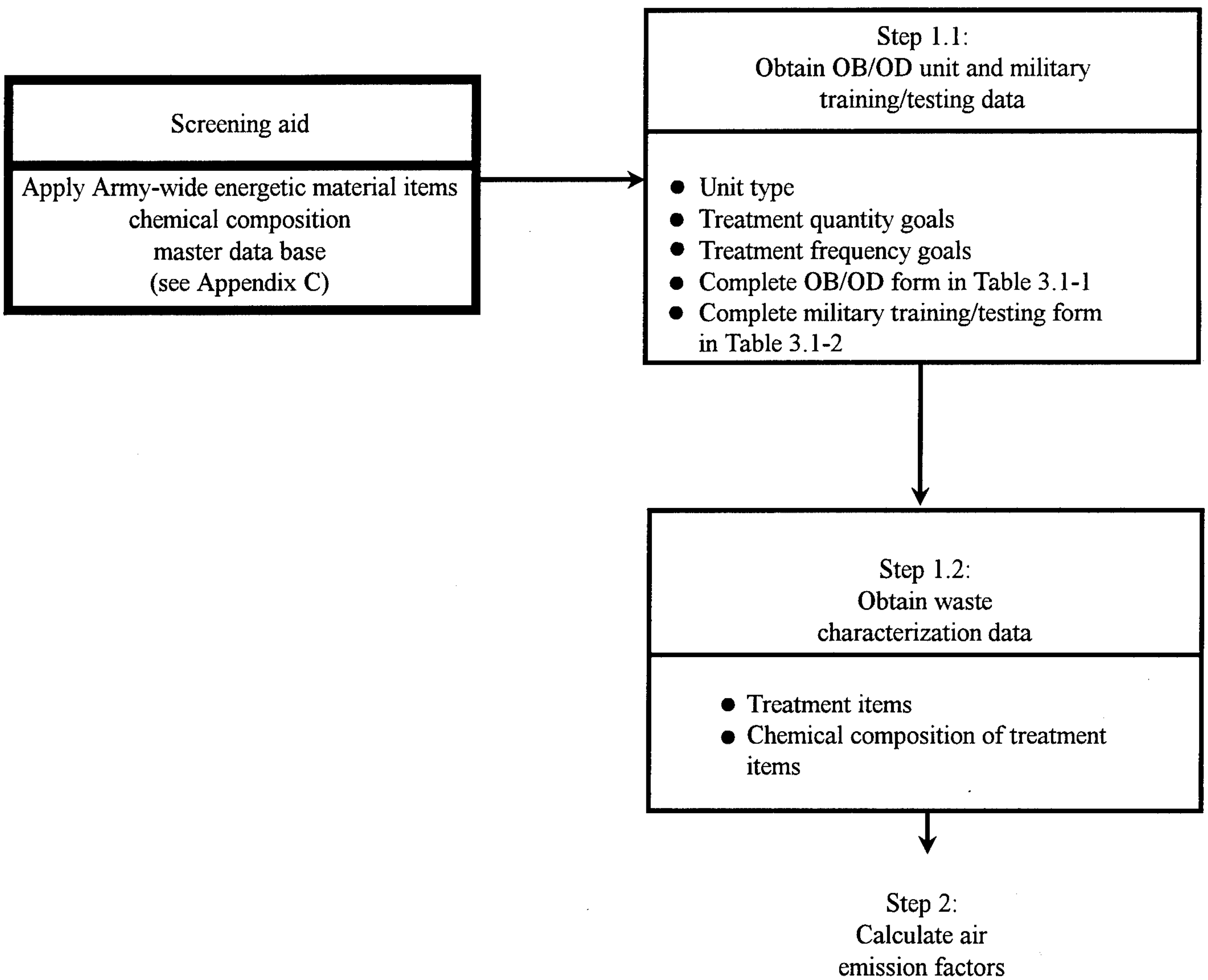


Fig. 3.0-1. Step 1: Obtain OB/OD unit and waste characterization data.

3.1 STEP 1.1: OBTAIN OB/OD UNIT DATA

Step 1.1 involves obtaining the following unit-specific data which are generally presented in the process information section of the Subpart X permit application:

- Unit type (OB or OD)
- Treatment quantity goals
- Treatment frequency goals
- Utilization of donor charges

This information can be conveniently documented on an OB/OD unit data form as presented in Table 3.1-1. The treatment goals data will be used to specify treatment limit goals as input to the air pathway assessment.

Installations frequently use a donor charge to ensure the most effective destruction of waste energetic material items during OD treatment. Typically a quantity of donor charge is used which is equivalent to the net explosive weight of the waste energetic material items to be treated by OD. Composition C-4 (90% RDX and 10% plasticizer, such as polyisobutylene) is generally used for the donor charge. The use of a donor charge is not subject to RCRA, since the donor charge is being used for its intended purpose. However, the regulatory agencies have been requiring that the air pathway assessments account for all treatment emissions. Therefore, emissions from the donor charge should be accounted for in Subpart X air pathway assessments.

It may also be necessary to obtain information regarding military training and testing (if energetics material items are utilized) at these installations. Emissions from the use of energetic material items for these activities can contribute to background air quality levels which need to be accounted for as part of the impact assessment. Quantities (in terms of NEW) of munitions and bulk propellants used should be identified as indicated in Table 3.1-2. Areas at which military training and testing activities are conducted should also be identified.

Table 3.1-1. OB/OD unit data form[a]

Treatment goals	OB	OD
• Net explosive weight (NEW)		
Treatment quantity (lbs)		
+ Annual		
+ Daily maximum		
+ Per OD pit		
- Maximum		
- Average		
- Minimum		
+ Per OB pan		
- Maximum		
- Average		
- Minimum		
• Donor charge (OD only)		
+ Typical ratio of donor NEW to energetic material item NEW		
+ Type of donor used[b]		
• Dunnage used (OB only)		
+ Volume and/or weight for pan		
• Wet propellants treated (OB only)		
+ Percent of OB treatment event		
+ Typical water content		
• Treatment frequency		
+ Annual total number of treatment days		
+ Maximum number of OD pits per treatment event		
+ Maximum number of OB burn pans per treatment event		

[a]Based on SOP limits.
[b]C-4 is typically used as a donor charge.

Table 3.1-2. Military training and testing data form

	Munitions		Bulk Propellants
	Cratering	Non-Cratering	
• Annual quantities used (NEW)			
+ Training			
+ Testing			
• Annual number of active days			
+ Training			
+ Testing			

3.2 STEP 1.2: OBTAIN WASTE CHARACTERIZATION DATA

Step 1.2 involves obtaining information for energetic material items which are candidates for OB/OD treatment at the installation of concern. These data are generally provided in the waste characteristics section of the Subpart X permit application and are used as modeling input for determining air emission factors.

A summary of the primary chemical constituents of energetic material items is presented in Table 3.2-1.

A complete munitions and/or ordnance item includes several components. Typical components may include a projectile, a propellant charge, and a primer that ignites the propellant. Other components such as a casing, fuzes, and bursting charge are frequently included. With few exceptions, these components contain one single or a mixture of energetic compounds. The U.S. Army is conducting a study to compile a computerized data base of the composition of individual military energetic material items as a component of the Munitions Items Disposition Action System (MIDAS). The MIDAS data base is being developed by the U.S. Army Defense and Ammunition Center School (USADACS) for AEC. When available, this comprehensive data base should be used to determine composition information for candidate items for OB/OD treatment.

The emphasis of this step and of the Subpart X permit application is on the energetic material composition (along with associated trace compounds and metals) of items to be treated by OB/OD which represents the net explosive weight (NEW). The metal hardware (casings, etc.) which cannot be safely removed prior to OB/OD treatment of military items is considered inert, with the possible exception of lead. A summary of typical metals and alloys used for these components is presented in Table 3.2-2. These materials for OD operations will become shrapnel and metal fragments which are deposited on and in the ground in the vicinity of the detonation location. Since these metals and alloys are resistant to degradation within the operational lifetime of OD units, the formation and migration of contaminants in the soil and water environment are not expected.

Certain items are prohibited from treatment by OB/OD pursuant to Army Regulation 200-1. These include military chemical warfare agents or related compounds, or materials contaminated with these agents. Typical military chemical warfare agents and related compounds include, but are not limited to, the following classes of agents:

- Choking agents
- Nerve agents
- Blood agents
- Blister agents
- Incapacitating agents
- Vomiting compounds
- Herbicides.

Table 3.2-1. General chemical composition of energetic material items

Propellants	
Name	Chemical Formula
Nitrocellulose	$C_{12}H_{16}(ONO_2)_4O_6$
Nitroglycerine	$C_3H_5N_3O_9$
Nitroguanidine	$CH_4N_4O_2$

These three primary constituents can be used singly or in various combinations along with metals, metallic salts, and organic polymer binders.

Primary Explosives	
Name	Chemical Formula
Lead Azide	H_6Pb (71% Pb)
Mercury Fulminate	$C_2HgN_2O_2$ (70.5% Hg)
Diazodinitrophenol (DDNP)	$C_6H_2N_4O_5$
Lead Styphnate	$C_6HN_3O_8Pb$ (44.2% Pb)
Tetracene	$C_2H_8N_{10}O$
Potassium Dinitrobenzofuroxane (KDNBF)	$C_6H_2N_4O_6K$
Lead Mononitroresorcinate (LMNR)	$C_6H_5NO_{4X}Pb$ (57.5% Pb)
Ingredients to Rocket Propellant:	
Copper Monobasic Salicylate	$C_{14}H_{12}Cu_2O_8$
Lead Salicylate	$C_{14}H_{10}O_6Pb$
Fuels:	
Lead Thiocyanate	$Pb(SCN)_2$ (64% Pb)
Antimony Sulfide	S_5Sb_2
Calcium Silicide	$CaSi_2$
Oxidizers:	
Potassium Chlorate	$KClO_3$
Ammonium Perchlorate	NH_4ClO_4
Barium Nitrate	N_2O_6Ba
Calcium Resinate	$Ca(C_{44}H_{62}O_4)_2$
Strontium Peroxide	SrO_2
Barium Peroxide	BaO_2
Strontium Nitrate	$Sr(NO_3)_2$
Potassium Perchlorate	$KClO_4$

Primary compositions include a mixture of primary explosive (as shown above), fuels, oxidizers and binders (e.g., paraffin wax).

Table 3.2-1. (continued)

Boosters and Secondary Explosives (High Explosives)	
Name	Chemical Formula
Aliphatic Nitrate Esters:	
1,2,4-Butanetriol Trinitrate (BTN)	$C_4H_7N_3O_9$
Diethyleneglycol Dinitrate (DEGN)	$C_4H_8N_2O_7$
Nitroglycerine (NG)	$C_3H_5N_3O_9$
Nitrostarch (NS)	$C_6H_7(OH)_X(ONO_2)_Y$ where X - Y = 3
Pentaerythritol Tetranitrate (PETN)	$C_5H_8N_4O_{12}$
Triethylene Glycol Dinitrate (TEGDN)	$C_6H_{12}N_2O_8$
1,1,1-Trimethylethane Trinitrate (TMETN)	$C_5H_9N_3O_9$
Nitrocellulose (NC)	$C_{12}H_{16}(ONO_2)_4O_6$
Nitramines:	
Cyclotetramethylene Tetranitramine (HMX)	$C_4H_8N_8O_8$
Cyclotrimethylene-Trinitramine (RDX)	$C_3H_6N_6O_6$
Ethylenediamine Dinitrate (EDDN, Haleite)	$C_2H_6N_4O_4$
Nitroguanidine (NQ)	$CH_4N_4O_2$
2,4,6-Trinitrophenylmethylnitramine (Tetryl)	$C_7H_5N_5O_8$
Ammonium Picrate (Explosive D)	$C_6H_3N_3O_7H_3N$
1,3-Diamino-2,4,6-Trinitrobenzene (DATB)	$C_6H_4N_5O_6$
2,2'4,4'6,6'-Hexanitroazobenzene (HNAB)	$C_{12}H_4N_8O_{12}$
Hexanitrostilbene (HNS)	$C_{14}H_2N_6O_{12}$
1,3,5-Triamino-2,4,6-Trinitrobenzene (TATB)	$C_6H_6N_6O_6$
2,4,6-Trinitrotoluene (TNT)	$C_7H_5N_3O_6$
Ammonium Nitrate	HNO_3H_3N

Table 3.2-1. (continued)

Compositions
Binary Mixtures:
Amotols (ammonium nitrate + TNT)
Composition A (RDX + Desensitizer)
Composition B (RDX + TNT)
Composition C (RDX + Plasticizer)
Ednatols (Haleite + TNT)
LX-14 [HMX (95.5%) + Estane 5702-F1]
Octols (HMX + TNT)
Pentolite (PETN + TNT)
Picratol [Ammonium Picrate (52%) + TNT (48%)]
Tetrytols (TNT + Tetryl)
Tritonal [TNT (80%) + Flaked Aluminum (20%)]
Ternary Mixtures:
Amatex 20 [RDX (40%) + TNT (40%) + Ammonium Nitrate (20%)]
Ammonals (Ammonium Nitrate + Aluminum and TNT, DNT, or RDX)
HBX - High Blast Explosives (TNT + RDX + AlD_2 Wax + Calcium Chloride)
HTA-3 (HMX + TNT + Al Mixture 3)
Minol-2 (TNT + Ammonium Nitrate + Aluminum)
Torpex [RDX (41.6%), TNT (39.7%), Al (18.0%) Wax (0.7%)]
Quaternary Mixtures:
DBX [TNT (40%), RDX (21%), Ammonium Nitrate (21%), Al (18%)
Plastic Bonded Explosives (PBX):
Basic Explosive [RDX, HMX, HNS, or PETN + Polymeric Binder (Polyester, Polyurethane, Nylon, Polystyrene, Rubbers, Nitrocellulose, Teflon)]

Pyrotechnics
Combination of:
Oxidizer-Oxygen or Fluorine
Fuel - Powdered Aluminum or Magnesium
Binding Agents - Resins, Waxes, Plastics, Oils, Retardants
Waterproofing, Color Intensifier

Source: U.S. Army, September 1984

Table 3.2-2. Common metal alloys used for the construction of casings and other energetic material items hardware

Metal or alloy	Constituents	Approximate %
Aluminum alloys	Aluminum (Al)	Varies
	Bismuth (Bi)	
	Chromium (Cr)	
	Copper (Cu)	
	Iron (Fe)	
	Lead (Pb)	
	Magnesium (Mg)	
	Manganese (Mn)	
	Nickel (Ni)	
	Silicon (Si)	
	Titanium (Ti)	
	Zinc (Zn)	
Cartridge brass	Copper (Cu)	68.5-71.5
	Iron (Fe)	0.05
	Lead (Pb)	0.07
	Zinc (Zn)	28.15-31.15
	Others	0.15
Copper, electrolytic tough pitch	Copper (Cu)	99.9+
	Lead (Pb)	0.005
	Oxygen (O)	0.04
	Silver (Ag)	Varies
Copper, high quality (considered pure)	Antimony (Sb)	0.0001
	Arsenic (As)	0.0001
	Bismuth (Bi)	0.0001
	Carbon (C)	0.0008
	Copper (Cu)	99.99+
	Iron (Fe)	0.0005
	Lead (Pb)	0.00005
	Nickel (Ni)	0.0001
	Selenium (Se)	0.0001
	Silver (Ag)	0.00003
	Sulfur (S)	0.0001
	Tellurium (Te)	0.0001
	Tin (Sn)	0.00005
Lead, chemical	Antimony (Sb)	0.00067
	Arsenic (As)	0.00067
	Bismuth (Bi)	0.025
	Copper (Cu)	0.05
	Iron (Fe)	0.002
	Lead (Pb)	99.90
	Silver (Ag)	0.02
	Tin (Sn)	0.00067

Table 3.2-2. (continued)

Metal or alloy	Constituents	Approximate %
Lead, commercial pure	Antimony (Sb)	0.00475
	Arsenic (As)	0.0015
	Bismuth (Bi)	0.05
	Copper (Cu)	0.0015
	Iron (Fe)	0.002
	Lead (Pb)	99.94
	Silver (Ag)	0.0015
	Tin (Sn)	0.00475
Lead alloys	Antimony (Sb)	Varies
	Arsenic (As)	
	Bismuth (Bi)	
	Copper (Cu)	
	Iron (Fe)	
	Lead (Pb)	
	Silver (Ag)	
	Tin (Sn)	
Steel, non-stainless	Carbon (C)	Varies
	Chromium (Cr)	
	Copper (Cu)	
	Iron (Fe)	
	Nickel (Ni)	
	Manganese (Mn)	
	Molybdenum (Mo)	
	Phosphorus (P)	
	Silicon (Si)	
	Sulfur (S)	
	Vanadium (V)	
Tungsten carbide	Cobalt (Co)	4.0-7.0
	Tungsten (W)	93.0-97.0
Wrought brass	Copper (Cu)	94.0-96.0
	Iron (Fe)	0.05
	Lead (Pb)	0.03
	Zinc (Zn)	3.92-5.92
Yellow brass	Copper (Cu)	63.0-67.5
	Iron (Fe)	0.05
	Lead (Pb)	0.30
	Zinc (Zn)	32.15-36.65

A second group of compounds or mixtures should not be treated on a routine basis except under emergency conditions. These include:

- Smokes
  - Titanium tetrachloride (FM)
  - Sulfur trioxide - chlorosulfonic acid (FS)
  - Hexachloroethane (HC) mixture (6.68% grained aluminum, 46.66% zinc oxide, and 46.66% hexachloroethane)
  - White phosphorus (WP)
  - Bulk red phosphorus (RP)
  - Plasticized white phosphorus (PWP)
  - Oil smoke
  - Colored smokes (red, yellow, green, violet, white, etc.)

- Incendiaries
  - Eutectic white phosphorus (EWP)
  - Napalm B (50% polystyrene, 25% benzene, and 25% gasoline by weight)
  - Thermite mixtures (i.e., TH_3, which contains 68.7% thermite, 29.0% barium nitrate, 2.0% sulfur, and 0.3% oil as a binder)
  - Tear-producing compounds (e.g., chloroacetophonone [CN], o-chlorobenzalmalonomitrile [CS])

Finally, OB/OD should not be conducted if any waste is not reactive.

3.2.1 Installation-Specific Waste Characterization Data

An installation-specific list of candidate treatment items that includes the following identification and treatment information should be compiled as soon as practical:

- Installation-specific item number sequential order for cross-reference purposes (e.g., 1, 2, 3, etc.)
- Department of Defense Ammunition Code (DODAC) number for each item
- Item type (e.g., propellant, primer, fuzes, cartridge)
- Item description (i.e., additional item identification information)
- Treatment method (OB and/or OD)
- Treatment unit for each item.

DODAC numbers are available from the following reference:

U.S. Army, Hazard Classification of United States Military Explosives and Munitions, Army Material Command, Savanna, Illinois, March 1990.

Chemical composition (weight percent data) should be compiled for the constituents of each energetic material item to be treated by OB/OD. Where weight percentages vary for a constituent, midpoints should be selected. Following are some of the standard sources for obtaining chemical composition data:

- U.S. Army, Development and Readiness Command (DARCOM), Pamphlet 700-32, Complete Round Charts, Ammunition through 20mm, November 1976.

- U.S. Army, Environmental Hygiene Agency, Air Pollution Engineering Division, U.S. Army Propellant/Munitions Compositions (Draft), August 1989/May 1990.

- U.S. Army, Technical Manual 43-0001-28, Army Ammunition Data Sheets, Artillery Ammunition Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers, and Artillery Fuzes, April 1977.

- U.S. Army, Development and Readiness Command (DARCOM), Pamphlet 700-3-3, Logistics Complete Round Charts, Activity Ammunition and Fuzes, June 1989.

- U.S. Army, AMC Pamphlet 700-3-5, Logistics Complete Round Charts, Grenades, Mines, Pyrotechnics, Rockets, Rocket Motors, Demolition Material, May 1975 and 1970.

- U.S. Army, Technical Manual 43-0001-29, Army Ammunition Data Sheets for Grenades, October 1977.

- U.S. Army, Department of the Army Field Manual 5-25, Explosives and Demolitions, February 1991.
- U.S. Army, Technical Manual 43-0001-36, Army Ammunition Data Sheets for Land Mines (FSC 1345), February 1977.
- NAVSEA SN060-AA-MMA-010 (formerly OP2212) 0640-LP-285-9800, Technical Manual Demolition Materials, First Revision, September 1, 1989.
- Rudolf Meyer, Explosives, Third Revised and Extended Edition, VCH Verlagsgesellschaft mbH, Weinheim, Germany, 1987.
- U.S. Navy, Computer Predictions of Pollution Products from Open Burning and Open Detonation of Explosives and Propellants, Final Report, Indian Head, Maryland, August 4, 1989.

Table 3.2.1-1 provides an example format for presenting information needed for Step 1.2 as discussed above.

Table 3.2.1-1. Example format for presenting chemical composition data for energetic material items treated by OB/OD

Item No.	DODAC No./item type/ item description	Treatment type	Constituent	Weight percent
1	Propellant, M1	OB	Nitrocellulose	85.00
			Dinitrotoluene	10.00
			Dibutylphthalate	4.00
			Diphenylamine	1.00
2	Propellant, M10	OB	Nitrocellulose	97.90
			Potassium sulfate	1.00
			Diphenylamine	1.00
			Graphite	0.10
3	Propellant, M26	OB	Nitrocellulose	67.25
			Nitroglycerine	25.00
			Ethyl centralite	6.00
			Potassium nitrate	0.70
			Barium nitrate	0.75
			Graphite	0.30
4	Propellant, M26E6 (M26E1)	OB	Nitrocellulose	68.70
			Nitroglycerine	25.00
			Ethyl centralite	6.00
			Graphite	0.30
5	Propellant, M30A2	OB	Nitrocellulose	27.05
			Nitroglycerine	22.55
			Nitroguanidine	46.30
			Ethyl centralite	1.30
			Potassium nitrate	2.80
6	Propellant, M31A1	OB	Nitrocellulose	20.00
			Nitroglycerine	19.00
			Nitroguanidine	54.00
			Dibutylphthalate	4.50
			Potassium sulfate	1.50
			Diphenylamine	1.00
7	Black powder (Class 1 and Class B)	OB	Potassium nitrate	74.00
			Charcoal	15.60
			Sulfur	10.40
8	Flash powder	OB	Barium nitrate	30.00
			Aluminum	40.00
			Potassium perchlorate	30.00
9	1305-A652, cartridge, 20mm TP-T M220 Series LNKD	OD	Nitrocellulose	75.50
			Dinitrotoluene	0.88
			Potassium nitrate	1.32
			Diphenylamine	1.32
			Tin dioxide	1.32
			Dibutylphthalate	7.46
			Nitroglycerine	9.66
			Barium nitrate	0.19
			Lead styphnate	0.18
			Strontium nitrate	1.43
			Magnesium powder	0.7

3.2.2 Army-Wide Waste Characterization Data

As a screening aid, an interim Army-wide data base of the chemical composition of energetic material items has been prepared. This extensive data base can be considered representative of the thousands of items which are candidates for OB/OD treatment. Therefore, this data base can be used in its entirety to represent typical and worst-case Army-wide OB/OD treatment scenarios. Thus, the data base can be used to support Army-wide air pathway screening assessments and can be used in lieu of compiling installation-specific data. This interim data base (which is limited to characterization of the NEW) is expected to be eventually replaced by MIDAS.

All of the munitions and ordnance that have DODAC numbers have been grouped into the following consolidated families:

1. Small arms, fuzes and primers
   - 1a. Small arms ammunition less than or equal to 50 caliber, all types (not classified as a hazardous waste)
   - 1b. Fuzes, all types
   - 1c. Primers, squibs, detonators, and other devices used to initiate detonation
2. Smokes and dyes
3. Pyrotechnics
4. High-explosive-loaded projectiles
   - 4a. Gun ammunition greater than 50 caliber and less than or equal to 40mm, all types except smoke, riot control agents, or chemical
   - 4b. Gun ammunition greater than 40mm, all types except smoke, riot control agents, or chemical
5. Rockets and missiles
6. Bombs, torpedoes, and depth charges
7. Riot control agents
8. Bulk explosives (except fuzes, detonators, and related items)
9. Grenades and mines (all types except smoke, riot control agents, chemical, or fuzes)
10. Navy gun ammunition (all types except propellant charges)
11. Special function projectiles
12. Propellants and propellant charges
    - 12a. Propellants
    - 12b. Propellant charges
13. Inert loaded items (no energetics and not appropriate for OB/OD)
14. Miscellaneous items (primarily related to aircraft ejection systems)

A listing of energetic material items with DODAC numbers (approximately 2,400) and major propellants classified into these 14 families is presented in Appendix C-1. Approximately 500 of these items have been characterized and these are so identified in Appendix C-1. A computer disk of the chemical composition for these characterized items is presented in Appendix C-2. A breakdown of the percent of items characterized by family is provided in Table 3.2.2-1.

Table 3.2.2-1. Percent of energetic material items characterized

	Munition class	No. of items characterized	Total count	Percentage of total munitions characterized
1a.	Small arms ammunition less than or equal to 50 caliber, all types	18	211	8.5
1b.	Fuzes, all types	18	215	8.4
1c.	Primers, squibs, detonators, and other devices used to initiate detonation or deflagration	36	204	17.6
2.	Smokes and dyes	38	168	22.6
3.	Pyrotechnics	10	142	7.0
4a.	Gun ammunition greater than 50 caliber and less than or equal to 40 mm, all types except smoke, riot control agents, or chemical	58	199	29.1
4b.	Gun ammunition greater than 40 mm, all types except smoke, riot control agents, or chemical	83	143	58.0
5.	Rockets and missiles	12	285	4.2
6.	Bombs, torpedoes and depth charges	11	127	8.7
7.	Riot control agents	8	41	19.5
8.	Bulk explosives (except fuzes, detonators, and related items)	27	138	19.6
9.	Grenades and mines (all types except smoke, riot control agents, chemical, or fuzes)	17	38	44.7
10.	Navy gun ammunition (all types except propellant charges)	32	145	22.1
11.	Special function projectiles	2	14	14.3
12a.	Propellants	114	150[a]	76.0
12b.	Propellant charges	14	88	15.9
13.	Inert loaded items (no energetics and not appropriate for OB/OD)	0	10	0
14.	Miscellaneous items (primarily related to aircraft ejection systems)	3	215	1.4
TOTAL		501	2,533	19.7

[a]Estimate.

The minimum, average, and maximum chemical compositions by weight percent of each of the 14 families are summarized in Appendix C-3. OB and OD treatment involves different sets of these 14 families, as illustrated in Figure 3.2.2-1. (It should be noted that family 1a, small arms ammunition less than or equal to 50 caliber, has been included in the master data base but not in OB and OD treatment categories, since energetic waste incinerators are an available treatment alternative. However, if family 1a is treated at an installation the associated waste constituents should be accounted for.) The average range of composition by weight for these OB and OD family combination sets is provided in Appendix C-4. These composition values are used as input to determine OB and OD emission factors as discussed in Step 2 (Section 4.0).

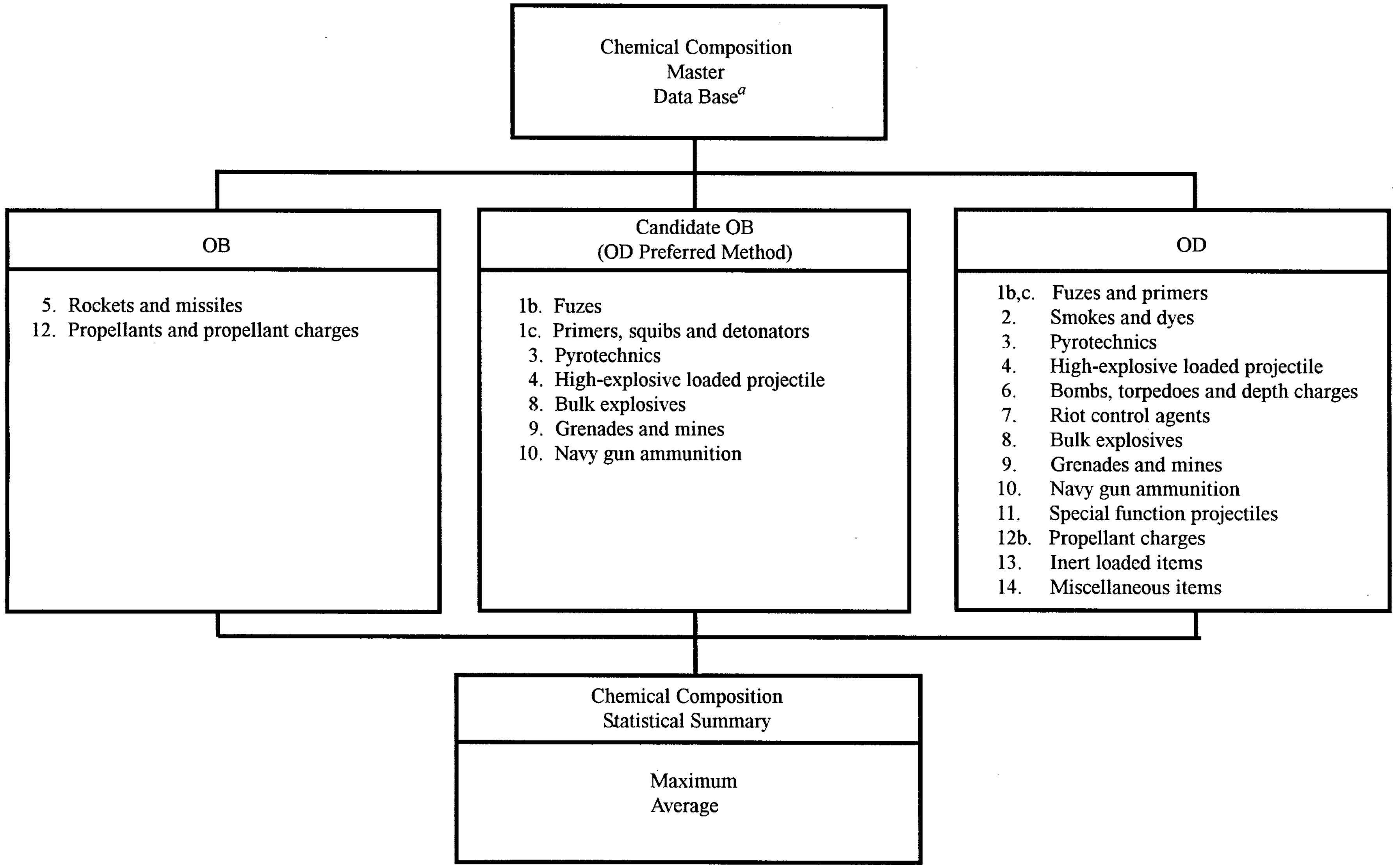
The casings and other metal hardware components of munitions and ordnance also need to be accounted for, in addition to the NEW component. Approximately 100 items were evaluated (see Appendix C-5) to determine the typical casing to energetic material ratio (3.7:1) and the following average casing composition:

- Brass 3%
- Copper <1%
- Aluminum <2%
- Fiberglass <1%
- Plastic <1%
- Carbon Steel 92%

Brass consists of approximately 85% copper and 15% zinc. The manganese content of carbon steel is approximately 0.6%. Styrene (which is also a potential OD treatment emission) was selected as a surrogate for plastic and fiberglass. Therefore, the following casing composition has been assumed:

- Copper 3.55%
- Zinc 0.45%
- Aluminum 2%
- Styrene 2%
- Manganese 0.55%
- Iron 91.45%

These data have also been used as input for Step 2: Calculate Air Emission Factors.



[a] Small arms ammunition < 50 caliber included in master data base but not in OB, OD categories since energetic waste incinerators constitute an available alternative and these small ammunitions are not considered as hazardous waste.

Fig. 3.2.2-1. Energetic material items chemical composition data base.

4.0 STEP 2: CALCULATE AIR EMISSION FACTORS

Air pathway assessments for OB/OD units involve accounting for OB/OD emissions as well as sources which contribute to the background air quality (see Fig. 4.0-1):

The approach to calculating emission factors for these sources is discussed in Sections 4.1 and 4.2. This involves determination of short-term emission factors based on worst-case conditions (to characterize exposure periods of 24 hours or less) and long-term emission factors based on average release conditions.

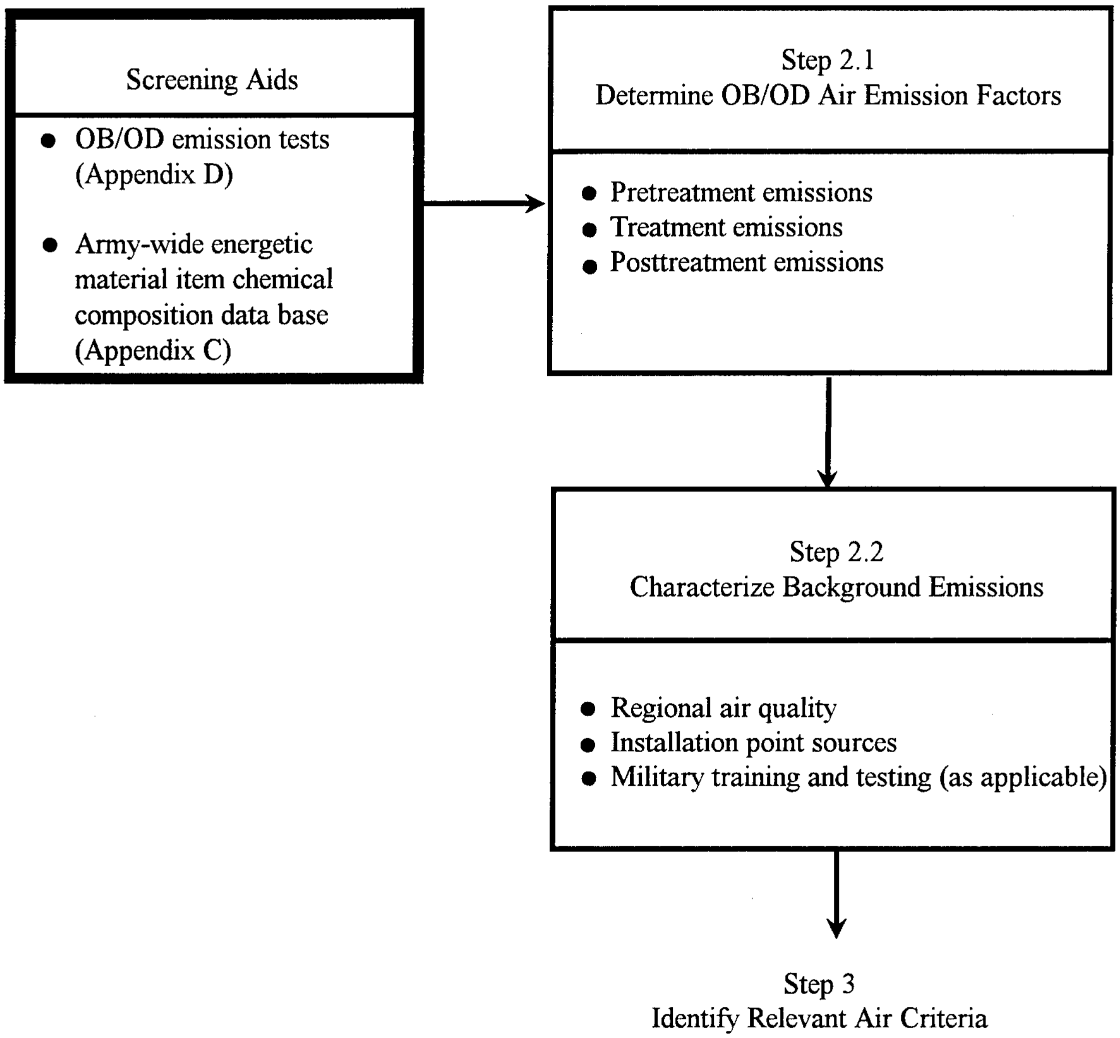


Fig. 4.0-1. Step 2: Calculate air emission factors.

4.1 STEP 2.1: DETERMINE OB/OD AIR EMISSION FACTORS

Air pathway assessments should account for the following potential emission sources associated with OB/OD operations (see Fig. 4.1-1):

- Pretreatment emissions (Step 2.1.1)
- Treatment emissions (Step 2.1.2)
- Posttreatment emissions (Step 2.1.3)

The determination of emissions factors for each of these OB/OD treatment stages is discussed in Sections 4.1.1 through 4.1.3.

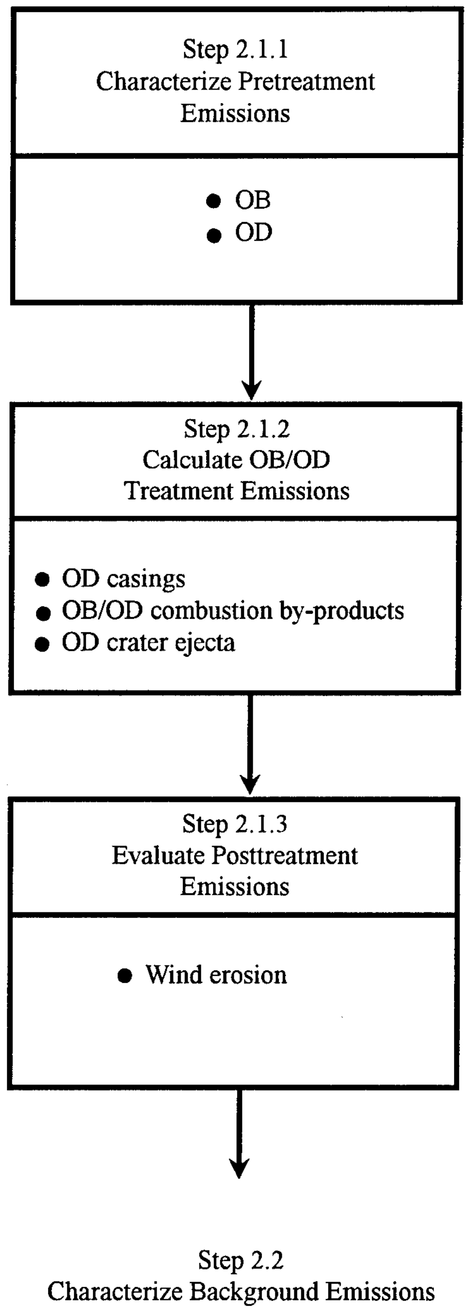


Fig. 4.1-1. Step 2.1: Determine OB/OD air emission factors.

4.1.1 Step 2.1.1: Characterize Pretreatment Emissions

Pretreatment emissions at an OB/OD unit are generally negligible and considered to be zero for the air pathway assessment. Potential pretreatment emissions sources are identified in Fig. 4.1.1-1.

Potential pretreatment air emissions sources associated with both OB and OD are as follows:

- Vehicular traffic
- Excavation (OD only)
- Waste unloading/loading
- Wind erosion/volatilization of the waste

Waste energetics are delivered by truck to the OB/OD unit. These volatiles travel at a low speed (generally 15 miles per hour or less) on the unit; some off-road travel may be involved. The potential for fugitive dust from this vehicular traffic is considered insignificant.

Pretreatment activities for OD include excavation of pits (for many installations) and placement of the waste energetic material items in the pit/detonation area. The potential for fugitive dust from the excavation is considered minimal.

Waste energetic material items are unloaded from the delivery trucks and placed in burn pans (for OB) or pit/detonation areas (for OD). The wastes are then treated, typically within 1 to 3 hours. All materials treated by OB/OD are solids, and the vapor pressure of the energetics treated is negligible.

Generally only propellants which are granular in nature are treated by OB. Some of these propellants are containerized within bags and are thermally treated in this mode. The high sides of the burn pan prevent spillage during loading operations (as well as minimize ejecta during the burn process). OB operations are generally limited to wind speeds of less than 20.0 miles per hour. In the event of any accidental spillage during the loading operation, the material is recovered and placed in the pan.

Energetics treated by OD are all encapsulated such that there are no fugitive particulates or volatile emissions.

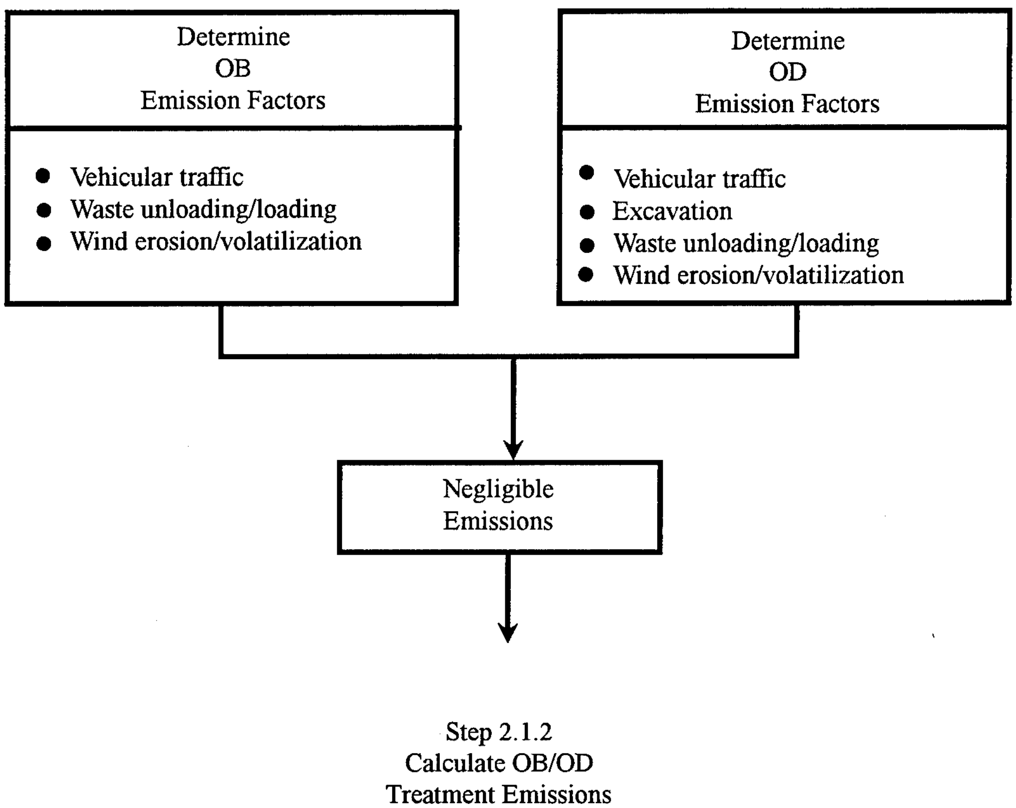


Fig. 4.1.1-1. Step 2.1.1: Characterize pretreatment emissions.

4.1.2 Step 2.1.2: Calculate OB/OD Treatment Emissions

OB/OD treatment emissions involve consideration of the following potential contributors, as indicated in Fig. 4.1.2-1:

- Casings and other metal parts (OD)
- Combustion by-products (OB/OD)
- Crater soil ejecta (OD)

Steps 2.1.2.1 through 2.1.2.3 address the determination of these emissions as discussed in Section 4.1.2.3.

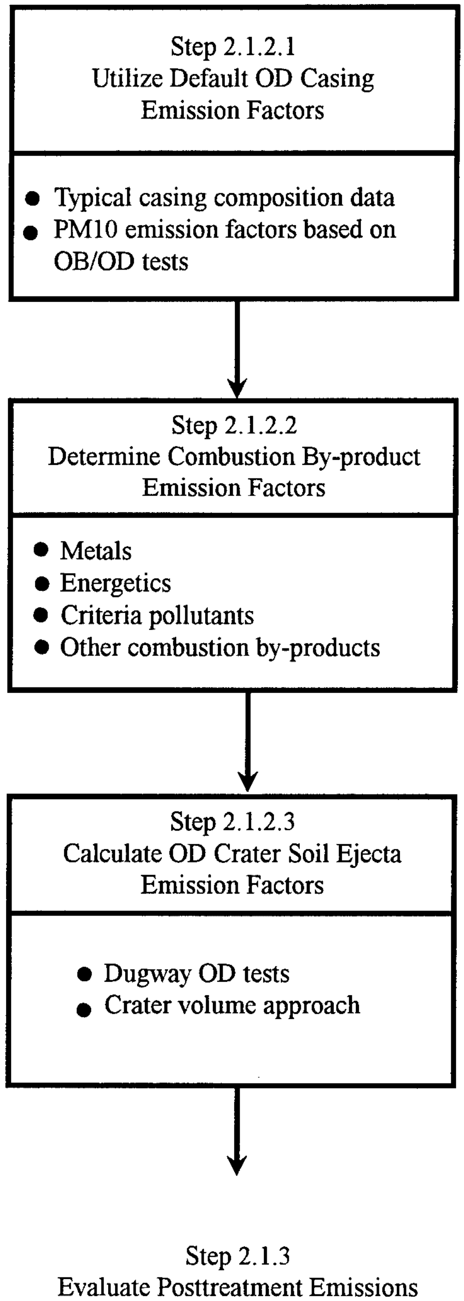


Fig. 4.1.2-1. Step 2.1.2: Calculate OB/OD treatment emissions.

4.1.2.1 Step 2.1.2.1: Utilize Default OD Casing Emission Factors

Energetic material items treated at the OD unit are enclosed in casings and also have various other metal parts which are not considered part of the NEW. These metal components of energetic material items are referred to in this document as "casings" for brevity. It is expected that during the detonation process most of the casing material becomes shrapnel which lands on the soil surface and within the OD crater of the OD unit. These pieces of inert metal alloys are not highly mobile in the soil and water environment. Those metal components of energetic material items subject to OD generally do not represent a potential air emission source.

A summary of the approach recommended for estimating casing emission factors is presented in Fig. 4.1.2.1-1.

On an annual basis the average composition of the casing is estimated as follows (pursuant to the discussion in Section 3.2):

- Brass <3%
- Copper <1%
- Aluminum <2%
- Fiberglass <1%
- Plastic <1%
- Carbon Steel 92%

Brass consists of approximately 85% copper and 15% zinc. The manganese content of carbon steel is approximately 0.6%. Styrene (which is also a potential OD treatment emission) was selected as a surrogate for plastic and fiberglass. Therefore, the following casing composition has been assumed:

- Copper 3.55%
- Zinc 0.45%
- Aluminum 2%
- Styrene 2%
- Manganese 0.55%
- Iron 91.45%

The Army has conducted OD emission tests for the Military Services (U.S. Army, January 1992; U.S. Air Force, January 1994). These tests have included energetic material items with casings. The relatively high particulate (PM10) emission factors (compared to energetics without casings) based on these tests are assumed to including casing contributions. Therefore, the tests' average (0.24 lb/lb) and 95 percentile upper confidence limit (0.63 lb/lb) particulate (PM10) emission factors have been used to determine conservative long-term (greater than 24 hours) and short-term (24 hours or less) casing emissions, respectively. Hopefully, future OB/OD BangBox tests will provide additional information regarding metal emissions from casings.

The previously specified chemical composition fractions for typical casings were multiplied by the test-derived particulate emission factors to obtain conservative constituent-specific emission factors for casings as presented in Table 4.1.2-1.

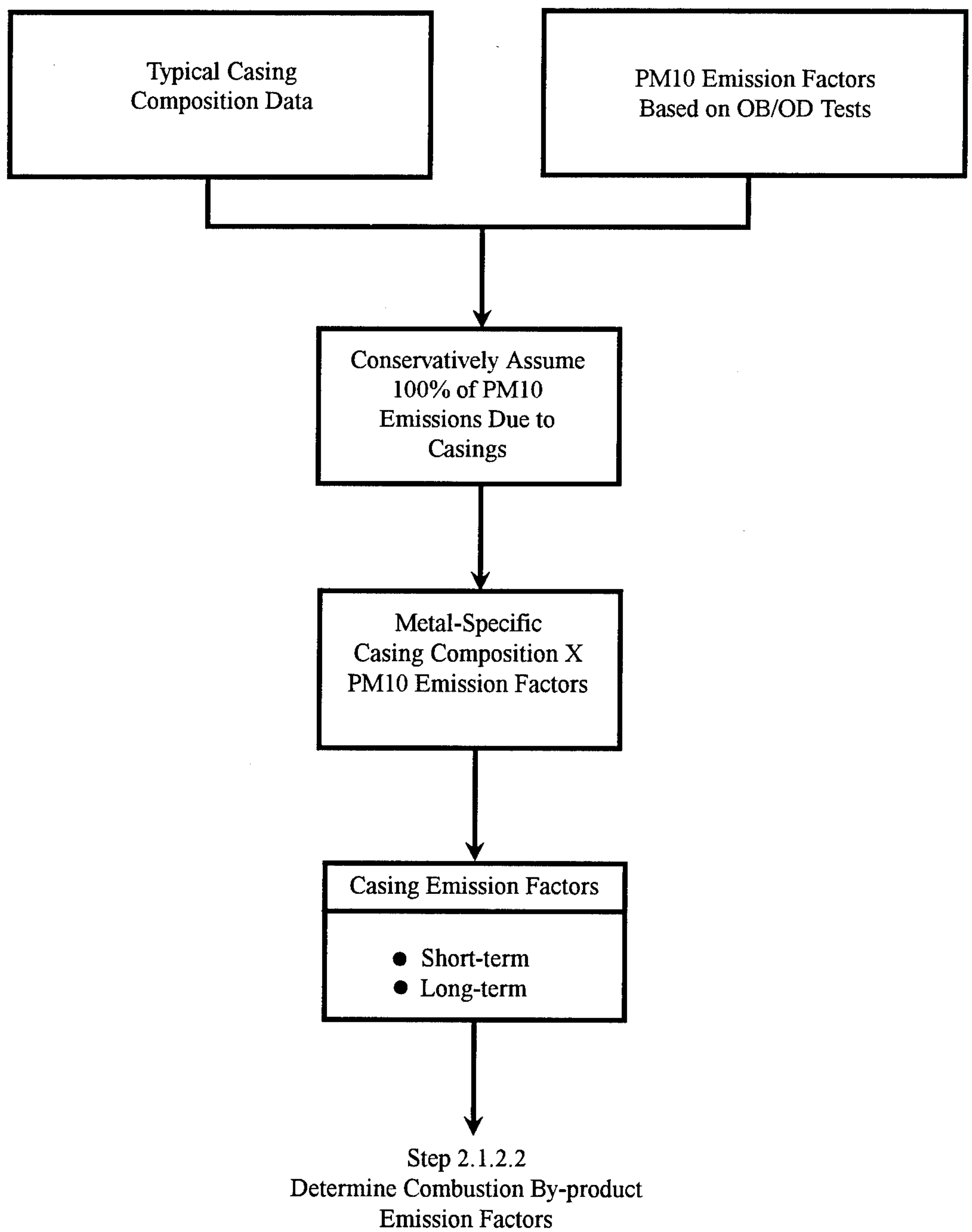


Fig. 4.1.2.1-1. Utilize default OD casing emission factors.

Table 4.1.2-1. Default PM10 casing emission factors for OD (lb emitted per lb NEW)

Constituent	Short-term (≤24-hr exposures)	Long-term (>24-hr exposures)
Copper	2.2 E-2	8.5 E-3
Zinc	2.8 E-3	1.1 E-3
Aluminum	1.3 E-2	4.8 E-3
Styrene	1.3 E-2	4.8 E-3
Manganese	3.5 E-3	1.3 E-3
Iron	5.8 E-1	2.2 E-1

The casing emission factors indicated in Table 4.1.2-1 correspond to an average casing to NEW ratio of about 3.2:1, with a range from 1:1 to 5.5:1. These default values are considered representative of most OD conditions, and refined adjustments to account for different casing-to-NEW ratios are not warranted for most screening assessments or justified considering the limitations of the available test data. However, for some cases it may be warranted to adjust the default OD casing emission factors to account for installation-specific casing-to-NEW ratios. Also, the casing emission factors presented in Table 4.1.2-1 represent only the PM10 (i.e., inhalable particulates) fraction of the total casing emission. The rest of the casing emissions will be larger than 10 microns in diameter and may include large pieces of shrapnel.

4.1.2.2 Step 2.1.2.2: Determine Combustion By-product Emission Factors

Potential emissions from OB/OD units include products of combustion as well as products of incomplete combustion. Together these emissions are referred to in this document as combustion by-products. Energetic compounds are composed principally of carbon, hydrogen, nitrogen and oxygen. The primary air emissions are products of combustion, which typically include the following:

- Carbon monoxide
- Carbon dioxide
- Nitrogen and nitrogen oxides
- Water
- Sulfur dioxide
- Methane

Secondary air emissions include various products of incomplete combustion (which can include energetic materials, organics, and trace metals).

Direct measurement of air emissions on a site-specific basis is not practical due to the extremely violent nature and short-term duration of emissions from OB/OD treatment. The Army has conducted special tests to characterize emissions from OB and OD for the Military Services (U.S. Army, January 1992; U.S. Air Force, January 1994). An approach has been developed for determining air emission factors utilizing data from the emission studies and constituent compositions.

The approach for developing emission factors has been based on the following:

- Mass balance assumptions for metals
- OB/OD emission tests conducted by the U.S. Army and U.S. Air Force
- Destruction removal efficiency (DRE) applied to energetic constituents

This approach is summarized in Fig. 4.1.2.2-1 and Table 4.1.2.2-1.

A mass balance approach in conjunction with the chemical composition inventory for candidate treatment items (as presented in Section 3.1 and Appendix C) has been used to determine conservative default emission factors for metallic constituents (see Table 4.1.2.2-2). (Some potential metal emission constituents may only be applicable to a limited number of items or families to be treated. Thus, a more refined list of metal emissions may be warranted for some installations.) Any metals that are present in the waste feed are assumed to be emitted completely, i.e., the destruction and removal efficiency (DRE) is 0%. The total weights for metallic compounds have been used to calculate the emission factors for each metal.

OB/OD test measurements have been used to determine emission factors for energetics and other combustion by-products. A representative range of energetic material items was tested as well as the expected worst-case scenario (i.e., TNT, which produces relatively larger quantities of products of incomplete combustion than do other energetics). A discussion of the OB/OD test program and a statistical summary of the results are presented in Appendix D-1.

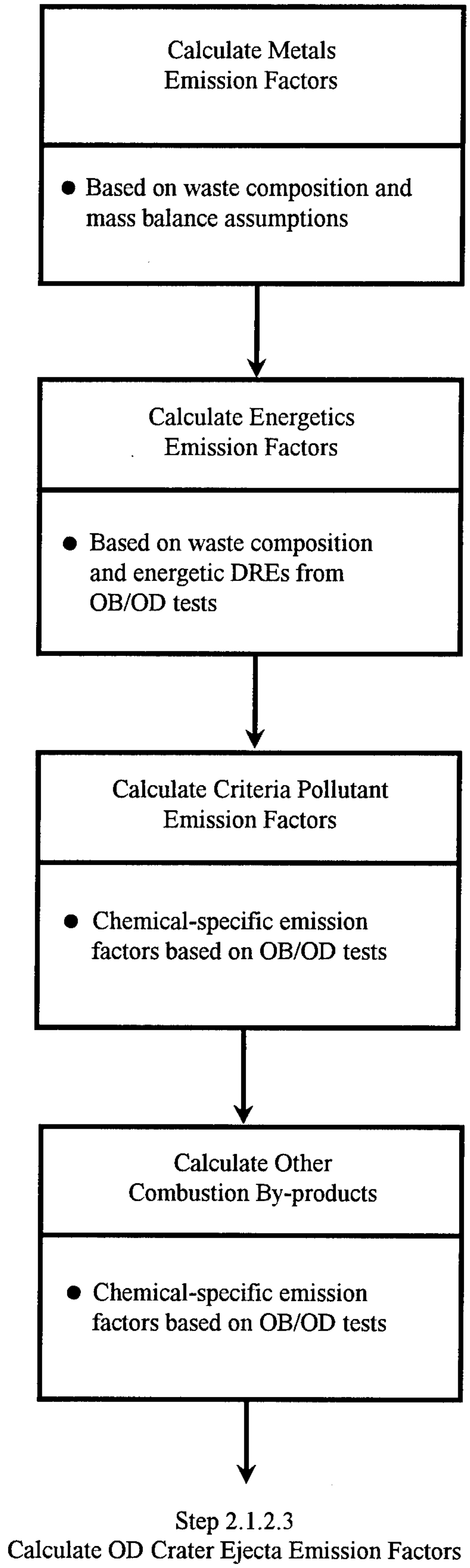


Fig. 4.1.2.2-1. Step 2.1.2.2: Determine combustion by-product emission factors.

Table 4.1.2.2-1. Basis for OB/OD treatment emission factors

Type emission contaminant	Basis for emission factors	Emission factors: Short-term (less than or equal to 24 hours)	Emission factors: Long-term (greater than 24 hours)
Metals	Mass balance assumption	Maximum metal constituent content considering all candidate treatment items.	Average metal constituent content considering all candidate treatment items.
Energetics	OD emission test measurements (energetic DRE)	Maximum energetic constituent content considering all available treatment items times the worst-case energetic DRE fraction.	Average energetic constituent content considering all available treatment items times the average energetic DRE fraction.
Criteria pollutants	OB/OD emission test measurements	95 percentile upper confidence level emission factor considering all tests.	Average emission factor considering all tests.
Other combustion by-products	OB/OD emission test measurements	95 percentile upper confidence level emission factor considering all tests.	Average emission factor considering all tests.

Table 4.1.2.2-2. Summary of combustion by-products default emission factors - metals (lb emitted per lb NEW)

Metals	OB[a] (Families 5, 12a and 12b)		OB[a] (Families 1b, 1c, 3-5, 9, 10, 12a and 12b)		OD (Families lb, 2-4, 6-11, and 14)	
	Short-term (≤ 24 hr)	Long-term (> 24 hr)	Short-term (≤ 24 hr)	Long-term (> 24 hr)	Short-term (≤ 24 hr)	Long-term (> 24 hr)
Arsenic[b]	-	-	-	-	-	--
Aluminum	4.0E-1	6.4E-3	4.0E-1	5.6E-3	2.0E-1	9.5E-3
Antimony[b]	-	-	5.0E-1	4.5E-1	2.2E-2	2.0E-4
Barium	3.0E-1	2.9E-3	4.1E-1	7.6E-3	4.1E-1	3.6E-3
Boron[b]	1.0E-3	1.0E-5	4.1E-3	1.0E-5	5.5E-3	7.0E-5
Calcium	5.0E-3	5.3E-4	8.3E-2	7.4E-4	3.5E-2	5.2E-4
Chromium	-	-	-	-	-	-
Copper	1.0E-2	7.0E-5	1.0E-2	3.0E-5	-	-
Iron	-	-	7.0E-2	3.0E-4	7.0E-2	3.9E-4
Lead	3.0E-2	4.5E-3	8.1E-1	2.6E-2	8.1E-1	1.2E-2
Manganese	-	-	-	-	-	-
Magnesium	1.0E-3	1.0E-5	4.5E-1	6.3E-3	4.5E-1	9.2E-3
Nickel	-	-	6.1E-2	1.8E-4	6.1E-2	2.4E-4
Potassium	8.7E-1	3.6E-2	8.7E-1	6.1E-2	7.5E-1	4.6E-2
Silver[b]	1.0E-2	7.0E-5	1.0E-2	3.0E-5	-	-
Sodium	3.0E-3	3.1E-4	1.0E+0	1.2E-2	1.0E+0	1.9E-2
Strontium[b]	-	-	1.1E-1	8.0E-4	1.1E-1	1.0E-3
Tin[b]	1.1E-2	3.4E-2	1.3E-2	4.2E-4	1.3E-2	3.8E-4
Titanium[b]	-	-	7.0E-2	1.8E-4	7.0E-2	2.4E-4
Zinc	-	-	5.4E-1	1.4E-3	5.4E-1	7.9E-3

[a]Includes families (1b, 1c, 3, 4, 9, and 10) which are candidates for OB, although OD is the preferred treatment method.
[b]Not a routine treatment constituent (use only as applicable).

A measure of the effectiveness of treatment of the OB/OD process is the DRE for energetics. The DRE values for OB/OD can be calculated as follows:

$$DRE_{Energetics} = (1.0 - EF_{Energetics})\ (100) \qquad \text{Eq. 4.2.2.2-1}$$

where

$DRE_{Energetics}$ = Destruction and removal efficiency for energetics (percent)

$EF_{Energetics}$ = Emission factor for energetics based on OB/OD emission tests (dimensionless)

A summary of DRE results based on OB/OD tests (U.S. Army, January 1992; U.S. Air Force, January 1994) is presented in Table 4.1.2.2-3. The available DRE test results indicate a consistent pattern of high DRE values (which approach the performance of a hazardous waste incinerator).

Table 4.1.2.2-3. Summary of OB/OD destruction and removal efficiency for energetics (DRE) for air pathway assessments

	DRE (%)	
Treatment	Short-term[a] (≤ 24 hrs)	Long-term[b] (> 24 hrs)
OB	99.9999+	99.9999+
OD	99.96	99.99

[a]Based on 95 percentile upper confidence level OB/OD test results.
[b]Based on average OB/OD test results.

The combustion efficiency (i.e., 1.0-DRE) times the waste composition factors (as presented in Appendix C.2) yields the emission factor for each energetic constituent. These default energetic emission factors are listed in Table 4.1.2.2-4.

Table 4.1.2.2-4. Summary of combustion by-products default emission factors - energetics (lb emitted per lb NEW)

	OB (Families 5, 12a and 12b)		OB[a] (Families 1b, 1c, 3-5, 9, 10, 12a and 12b)		OD (Families lb, 2-4, 6-11, and 14)	
	Short term	Long term	Short term	Long term	Short term	Long term
RDX	1.0E-6	7.2E-9	1.0E-6	1.1E-7	4.0E-4	4.5E-5
HMX	1.6E-7	2.2E-9	2.0E-7	1.4E-9	3.8E-4	3.0E-5
TNT	--	--	1.0E-6	4.4E-8	4.0E-4	1.5E-5
TNG	4.9E-7	1.5E-7	4.9E-7	7.5E-8	1.6E-4	2.6E-6
DIMP	-	-	-	-	-	-
DNT	1.3E-7	3.2E-8	1.3E-7	3.2E-8	4.0E-5	2.2E-6
DNB	-	-	-	-	-	-
HCE	-	-	-	-	1.8E-4	5.8E-7
WP[b]	-	-	8.3E-7	2.2E-9	4.0E-4	2.8E-6
Picric Acid	-	-	-	-	-	-
NG	5.5E-7	4.0E-8	5.5E-7	3.6E-8	2.2E-4	2.8E-6
Tetryl	-	-	1.0E-6	1.6E-8	4.0E-4	2.6E-6
TNB	-	-	1.4E-8	8.8E-9	9.1E-7	1.8E-7
Total	2.3E-6	2.1E-7	5.2E-6	3.6E-7	2.6E-3	4.7E-5

RDX - Cyclo-1,3,5-trimethylene-2,4,6-trinitramine
HMX - Cyclotetramethylene tetranitramine
TNT - Trinitrotoluene
TNG - Trinitroglycerol (Nitroglycerin)
DIMP - Diisopropyl methylphosphonate
DNT - 2,4- and 2,6-Dinitrotoluene
DNB - 1,3-Dinitrobenzen
HCE - Hexachloroethane
WP - White phosphorus
NG - Nitroguanidine
Tetryl - Trinitro-2,4,6-phenylmethylnitramine
TNB - 1,3,5 Tinitrobenzo

[a]Includes families (1b, 1c, 3, 4, 9, and 10) which are candidates for OB, although OD is the preferred treatment method.
[b]Not a routine treatment constituent (use only as applicable).

Measured emission factors based on OB/OD tests have been used directly to determine default values for criteria pollutants (see Table 4.1.2.2-5) and other combustion by-products (see Table 4.1.2.2-6).

Subsurface detonations for some enegetic material items have higher emission factors due to restrictions on available oxygen. It is anticipated that factor OD BangBox tests to be conducted by Dugway Proving Ground will involve subsurface detonations.

Table 4.1.2.2-5. Summary of combustion by-products default emission factors - criteria pollutants (lb emitted per lb NEW)

	OB[a]		OD	
Criteria pollutants[b]	Short-term (≤ 24 hr)	Long-term (> 24 hr)	Short-term (≤ 24 hr)	Long-term (> 24 hr)
Carbon monoxide	9.8E-4	3.9E-4	7.2E-2	3.9E-2
Nitrogen dioxide	1.9E-3	7.5E-4	3.2E-3	1.3E-3
Sulfur dioxide	1.7E-3	2.5E-4	2.2E-4	2.2E-4
Ozone	NA	NA	NA	NA
PM-10 (particulate matter ≤ 10 μm)	2.8E-2	1.1E-2	6.3E-1	2.4E-1

[a]Additional OB emission factors are needed if dunnage is burned and/or fuels are used to initiate the burn. U.S. EPA emission factors in AP-42 and other standard references can be used as available. Data are also available from POLU modeling (e.g., cellulose results for dunnage, fuel oil results as an igniter, etc.).

[b]Lead is addressed in Table 4.1.2.2-2.
NA = Not available.

Table 4.1.2.2-6. Summary of combustion by-products default emission factors - other combustion by-products (lb emitted per lb NEW)[a]

Other combustion by-products	OB		OD	
	Short-term (≤ 24 hrs)	Long-term (> 24 hrs)	Short-term (≤ 24 hrs)	Long-term (> 24 hrs)
1-Nitropyrene	1.9E-08	1.2E-08	6.4E-08	2.7E-08
1,3-Butadiene	-	-	2.4E-05	6.6E-06
1,3,5-Trinitrobenzene	1.4E-08	8.8E-09	9.1E-07	1.8E-07
1.6-Dinitropyrene	1.0E-08[b]	1.0E-08[b]	-	-
2-Methylnaphthalene	-	-	3.1E-06	8.3E-07
2-Methylphenol	-	-	1.0E-06	6.2E-07
2-Naphthylamine	1.0E-08[b]	1.0E-08[b]	-	-
2-Nitrodiphenylamine	1.3E-08	1.1E-08	2.9E-07	6.4E-08
2-Nitronaphthalene	8.1E-08	2.6E-08	2.0E-07	5.8E-08
2,2[1]-Methylene bis (4-methyl-6-t-butyl phenol)	-	1.0E-08[b]	-	-
4-Nitrophenol	-	-	1.2E-06	1.8E-07
5-ethyl-1,3-diglycidyl-5-methylhydentoin diepoxide	-	1.0E-08[b]	-	-
Acenaphthylene	-	-	6.4E-07	2.6E-07
Acetophenone	-	-	2.0E-07	1.5E-07
alpha, alpha-Dimethylphenethylamine	-	-	-	9.9E-07
Ammonia	2.0E-05	2.0E-05	-	2.9E-04
Anthracene	-	-	2.7E-07	1.6E-07
Aromatics (VOs, including Benzene)	-	-	3.2E-03	7.2E-04
Benzene	1.6E-05	5.6E-06	5.1E-04	1.3E-04
Benz(a)pyrene	7.5E-07	1.5E-07	2.8E-07	8.2E-08
Benz(b)fluoranthene	-	-	-	6.0E-07
Benzyl alcohol	-	-	1.2E-07	1.1E-07
Benzo(k)fluoranthene	-	-	-	4.8E-07
Benzo(a)anthracene	1.2E-07	3.3E-08	1.5E-07	4.7E-08
Benzo(c)acridine	-	1.0E-08[b]	-	-
Butyl benzyl phthalate	-	-	1.2E-06	5.1E-07
Chrysene	-	-	-	2.3E-07
Dibenzofurans	9.9E-05	1.7E-05	1.2E-06	2.4E-07
Dibenz(a,h)anthracene	1.0E-08[b]	1.0E-08[b]	-	4.3E-07
Di-n-butyl phthalate	-	-	3.8E-05	9.8E-06

Table 4.1.2.2-6. (continued)

Other combustion by-products	OB Short-term (≤ 24 hrs)	OB Long-term (> 24 hrs)	OD Short-term (≤ 24 hrs)	OD Long-term (> 24 hrs)
Diethyl phthalate	-	-	5.5E-07	2.7E-07
Diethylenetriamine	-	1.0E-08[b]	-	-
Dimethyl phthalate	-	-	4.7E-07	2.4E-07
Di-n-octyl phthalate	-	-	5.4E-06	1.7E-06
Di-n-propyladipate	-	1.0E-08[b]	-	-
Dioctylsebacate	-	1.0E-08[b]	-	-
Diphenylamine	2.6E-07	5.1E-08	2.3E-07	6.0E-08
Di(2-ethylhexyl)phthalate	-	-	3.5E-06	1.9E-06
Ethyl benzene	-	-	4.1E-05	1.0E-05
Fluoranthene	-	-	1.2E-06	4.2E-07
Fluorene	-	-	3.6E-07	2.5E-07
Hexane	-	-	3.2E-05	8.0E-06
Hydrogen cyanide	2.0E-05	2.0E-05	5.2E-03	2.3E-03
Isophoronedi-isocyanate	-	1.0E-08[b]	-	-
Methane	-	-	5.9E-03	2.0E-03
Naphthalene	1.7E-06	5.1E-07	1.7E-05	3.0E-06
Nitric oxide	5.3E-03	2.5E-03	9.2E-03	2.4E-03
N-Nitrosodiethylamine	-	-	-	1.2E-07
N-Nitrosodiphenylamine	1.2E-06	2.3E-07	2.6E-06	4.2E-07
Olefins (VOs)	-	-	1.9E-03	6.6E-04
o-Nitrophenol	2.1E-06	2.8E-07	-	-
Paraffins (VOs)	-	-	1.3E-04	8.5E-05
Phenanthrene	-	-	2.0E-06	5.4E-07
Phenol	8.7E-06	2.7E-06	7.9E-06	1.8E-06
Phenyl diisodecylphosphite	-	1.0E-08[b]	-	-
Pyrene	3.4E-07	8.4E-08	1.3E-06	3.6E-07
Resorcinol	-	1.0E-08[b]	-	-
Sallcylic acid	-	1.0E-8[b]	-	-
Styrene	-	-	1.8E-03	4.3E-04
TNMHC	6.3E-04	2.2E-04	3.7E-03	1.6E-03

Table 4.1.2.2-6. (continued)

Other combustion by-products	OB		OD	
	Short-term (≤ 24 hrs)	Long-term (> 24 hrs)	Short-term (≤ 24 hrs)	Long-term (> 24 hrs)
TO-12 (Total Organics C2-C15)	-	-	8.1E-03	2.5E-03
Toluene	-	-	2.7E-04	6.7E-05
Triacetin	-	1.0E-08[b]	-	-
Xylenes (Isomers and mixtures)	-	-	2.3E-04	5.4E-05

[a]Products of incomplete combustion (PICs).
[b]Detection limit.
– Not detected during available OB/OD emission tests.

4.1.2.3 Step 2.1.2.3: Calculate OD Crater Ejecta Emission Factors

Cratering effects associated with OD operations result in the ejection of soil materials into the air, some of which remain suspended and form a dust cloud. Most of the larger soil particles (i.e., greater than 30 microns) fall back to the ground within three to five crater radii of the OD event.

The process for developing installation-specific OD crater ejecta emission factors is illustrated in Fig. 4.1.2.3-1. Two alternative methodologies for estimating PM10 (particulate matter less than or equal to 10 microns) emission factors associated with crater ejecta have been identified, as discussed in Sections 4.1.2.3.1 and 4.1.2.3.2. Professional judgment should be used to select the best method, considering site-specific conditions and permitting issues.

The OD dust cloud which forms due to crater ejecta may contain trace amounts of soil contamination. These chemical-specific PM10 emission factors can be estimated by multiplying chemical-specific soil concentrations (based on site-specific sampling data) by the dust cloud PM10 emission factors. However, results from a comprehensive risk assessment for the Sierra Army Depot (the largest OB/OD operation in the United States, with an OD treatment capacity of about 52,000 tons per year) indicate that this air pathway is considered insignificant.

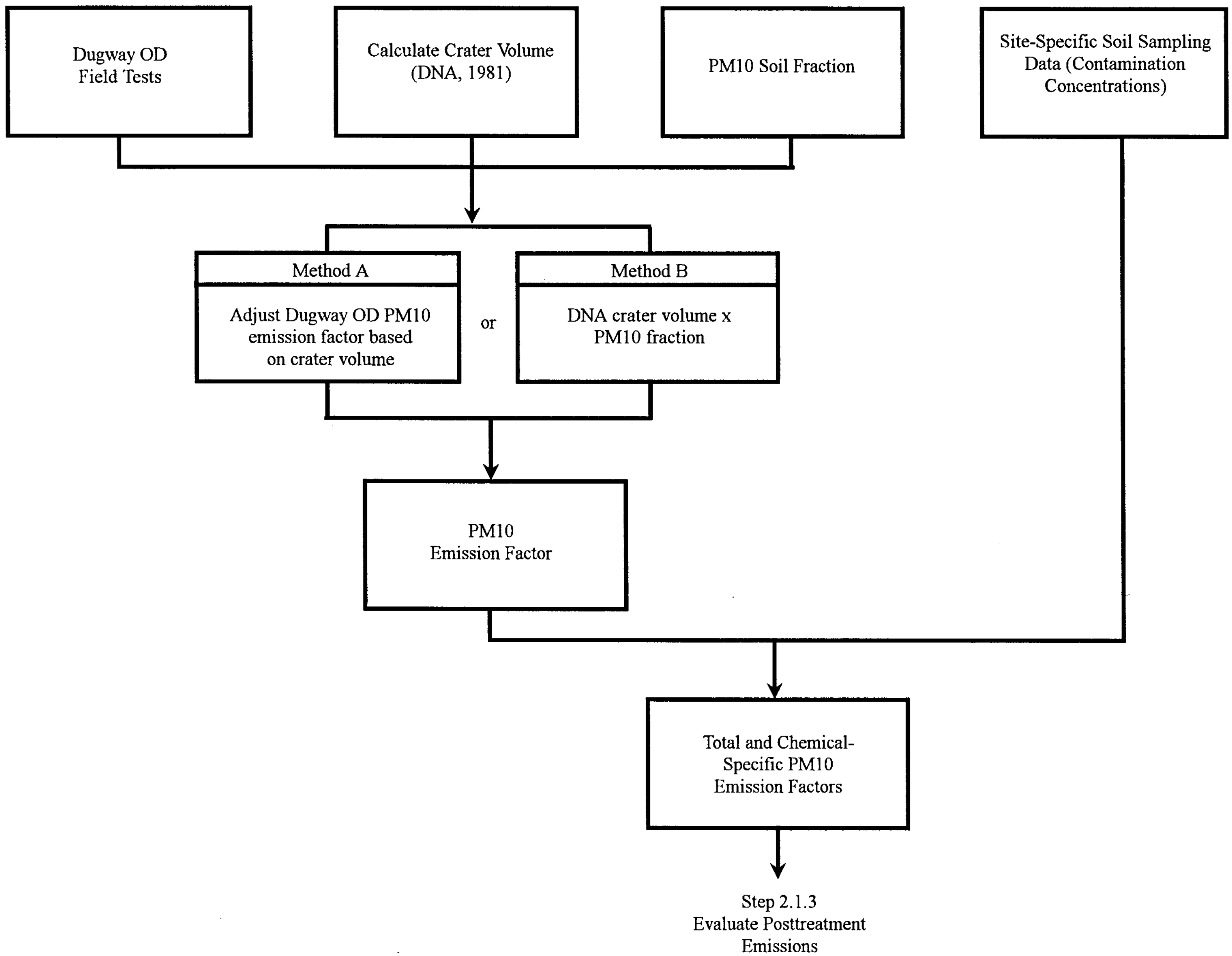


Fig. 4.1.2.3-1. Step 2.1.2.3: Calculate OD crater ejecta emission factors.

4.1.2.3.1 Method A

An approach based on OD expected crater volumes and installation-specific soil particle size distributions has been used to estimate OD fugitive dust emissions for Subpart X permitting.

A methodology based on crater volume estimates from high-explosion field tests evaluated by the DNA (October 1981) has been used to estimate the fugitive dust emission factors for OD operations. This methodology can be summarized as follows:

$$EF_{dc\text{-}PM10} = \frac{V_{ac} \times D_s \times F_{PM10}}{W_{lb}} \qquad \text{Eq. 4.1.2.3.1-1}$$

where

$EF_{dc\text{-}PM10}$	=	OD dust cloud emission factor for PM10 (respirable particulate of 10 microns or less) matter (lb of particulate per lb of material detonated)
V_{ac}	=	expected apparent crater volume (ft^3)
D_s	=	density of the soil (lb/ft^3)
F_{PM10}	=	fraction of crater volume which consists of particles less than or equal to 10 microns (dimensionless)
W_{lb}	=	net explosive weight of energetic material to be treated by OD (lb)

The expected apparent crater volume has been based on the following equations (DNA, October 1981):

$$V_{ac} = V_{ce} \times W_{gc} \exp\left[-5.2H_b \left(V_{ce}\ W_{gc}\right)^{-0.33}\right] \qquad \text{Eq. 4.1.2.3.1-2}$$

where

V_{ce}	=	cratering efficiency for a zero height of burst based on Table 4.1.2.3.1-1 (ft^3/ton)
W_{gc}	=	TNT-equivalent net explosive weight relative to ground cratering (tons)
H_b	=	height of the burst in feet; negative if below ground with soil cover (not applicable to more than a few charge radii below the surface)

and

$$W_{gc} = TF \times W \qquad \text{Eq. 4.1.2.3.1-3}$$

where

TF = TNT-equivalent weight factor relative to ground cratering efficiency which is related to total energy content and not to detonation velocity

W = net explosive weight detonation charge (tons)

Soil density is determined based on the applicable soil-texture classification considering installation-specific soil conditions. Estimates of the PM10 (respirable particles) content of the soil are also based on soil-texture classification or soil particle size data from installation-specific soil samples.

The TNT-equivalent weight factor, TF, relative to ground cratering efficiency generally ranges from 0.68 (for dynamite) to 1.34 (for C-4 explosives typically used as a donor charge) (DNA, October 1981).

Table 4.1.2.3.1-1. Summary of cratering efficiency values, V_{ce}

Medium	V_{ce} (ft^3/ton) Range	V_{ce} (ft^3/ton) Best estimate
Wet geology (including soils and clay shales)	2,000 to 8,000	4,000[a]
Dry soil	600 to 1,800	1,000[b]
Dry soft rock	500 to 1,200	800
Dry hard rock	300 to 700	500

[a]Wet clay = 10,000
Wet sand = 6,000
Wet coral sand = 4,000
Wet clay shale = 4,000
[b]Dry clay = 1,500
Dry sand = 1,500
Dry alluvium = 1,100
Playa = 800

Source: DNA, October 1981 (see Appendix D-2)

The above-referenced approach is extremely conservative and significantly overestimates the PM10 emission factor. This poor performance is attributed to a weaker correlation of the airborne distribution of small particles to the parent soil than might be expected based on various field tests. These differences may be due to soil analysis techniques that break up soil agglomerates, to the agglomeration of particles by explosive shock, and to other factors (U.S. Army, October 1987). Based on observations at many OD sites, a relative small dust cloud is formed after detonation and rapidly dissipates. Repeated detonations have not resulted in any significant net loss of soil from the OD area. Therefore, this leads to the conclusion that emissions of particulate matter are minimal and the DNA-based emission factor is an overestimate.

In addition, the approach is unrealistically conservative for subsurface detonations. This poor performance is attributed to limitations of the applicability of Eq. 4.1.2.3.1-2 (crater volume) to subsurface depths within a few charge radii from the soil surface. At greater depths, the predicted crater volumes become increasingly unrealistic. Actually, for subsurface OD events the ejecta will be increasingly in the form of clods (rather than small particles) for some soil conditions as the detonation depth increases. Installation-specific crater volume measurements or observations are recommended if possible.

4.1.2.3.2 Method B

Measurements of suspended particulates within OD clouds available from Army field tests conducted at Dugway Proving Ground (DPG) in 1989 and 1990 involving only surface detonations provide an alternative method to the approach discussed in Section 4.1.2.3.1 for the estimation of emission factors. These cloud particulate-concentration data, in conjunction with an estimate of the OD cloud volume, can be used to estimate the total mass of suspended particulates which have been emitted. The ratio of the mass of suspended particulates to the weight of the energetic material detonated provides an estimate of the suspended particulate emission factor applicable to OD dust clouds (i.e., accounting for particulates from incomplete combustion as well as entrained soil particles). It has been assumed that the total suspended particulate emission factor derived from the DPG tests can also be used to conservatively estimate PM10 emission factors.

Method B is based on use of the following relationship:

$$EF_x = \left(\frac{V_x}{1000}\right) EF_{dpg} \qquad \text{Eq. 4.1.2.3.2-1}$$

where

EF_x	=	PM10 emission factor for the OD dust cloud at installation "X" (dimensionless)
EF_{dpg}	=	PM10 emission factor for the OD dust cloud applicable to DPG dimensionless (see Table 4.1.2.3.2-1)
V_x	=	apparent crater volume applicable to installation "X" based on Eq. 4.1.2.3.1-1 (ft^3)
1000	=	apparent crater volume applicable to the OD field tests (1989-1990) at DPG for surface detonations and a best estimate of cratering efficiency of 1,000 ft^3/ton for dry soil based on Eq. 4.1.2.3.1-1 (1,000 ft^3)

Additional details regarding the derivation of Eq. 4.1.2.3.2-1 are presented in Appendix D-3.

Method B facilitates the use of available OD particulate measurements based on the field tests at DPG. By scaling the DPG results, this approach also accounts for the site-specific soil conditions at other installations. However, the approach is directly applicable only to surface detonations.

Table 4.1.2.3.2-1. Summary of recommended input to Equation 4.1.2.3.2-1

Basis	$EF_{dpg\text{-}PM10}$[a] (PM10 emission factors)	Applicable exposure period
DPG tests (Section 4.1.2.3.1 methodology)	1.0E1	Short term (24 hours or less)
DPG tests (Section 4.1.2.3.1 methodology)	5.7E0	Long term (greater than 24 hours)

[a]DPG emission factors (lb PM10 emitted per lb energetics treated) to be used on an Army-wide basis as input to Eq. 4.1.2.3.2-1 to determine installation-specific emission factors.

4.1.3 Step 2.1.3: Evaluate Posttreatment Emissions

Postdetonation activities at an OD unit involve backfilling the pits/craters by hand shovel or more typically with equipment such as a bulldozer or front-end loader. These backfilling operations are generally accomplished the same day as the OD event or soon thereafter. The potential for fugitive dust from this operation and associated vehicular road dust is minimal compared to the detonation cloud due to soil ejecta. Therefore, quantitative evaluation of this potential posttreatment emission source is not warranted for small-quantity OD treatment units.

At an OB unit posttreatment operations consist of removing any ash/residues from the burn pans and placing them in barrels or similar sealed containers. These activities typically occur the next day following an OB event (to allow for cooling of the pans as a safety measure). The sides of the burn pans mitigate the potential for wind erosion. In addition, the pans are generally covered if the ash/residue removal cannot be conducted within 24 hours. The average rate of OB ash/residue generation is 1 lb per 1,000 lb of energetic material treated (assuming dunnage is not used) based on Army tests (see Appendix D-4). Limited test data indicate that the ash/residues frequently do not have characteristics defined by EPA for classification as hazardous waste. Based on these considerations, further evaluation of this potential emission source is not warranted for small-quantity OB treatment units which do not use dunnage.

Past operations may have resulted in contamination of the surface soil in the vicinity of the OB/OD unit at an installation. In addition, there is the potential that ejecta and fallout from current and future OB/OD operations could result in soil contamination. Wind erosion of the contaminated surface soils, therefore, should be evaluated to determine offsite exposure (see Fig. 4.1.3-1).

Surface soil sampling data should be used, as available, to characterize contamination levels at the OB/OD unit (i.e., the source term). The U.S. Army Environmental Hygiene Agency (AEHA) conducted soil and groundwater sampling in the vicinity of OB/OD units for many Army installations. For many installations an environmental sampling program will be needed to support Subpart X permitting

Results from OB/OD field tests conducted by the Army should be considered in the design of the sampling program (U.S. Army, June 1992). Soil contamination should be assumed to be within a 15-m radius from each OB pan due to sputter ash and fallout ash. Soil contamination should be assumed to be within a 225-m radius from each OD pit due to ejecta and fallout, but the crater area itself represents a "hot spot." Additional discussion of the OB/OD test results is provided in Appendix D-3.

Wind erosion potential should be estimated based on the standard U.S. EPA techniques described in Sections 6 and 7 of the Control of Open Fugitive Dust Sources (U.S. EPA, September 1988). Wind erosion potential can be classified as either "limited" or "unlimited." The process for selection of the "limited" versus "unlimited" wind erosion model is illustrated in Fig. 4.1.3-2.

With regard to estimating particulate emissions from wind erosion of exposed surface material, site inspections can be used to determine the potential for continuous wind erosion. The

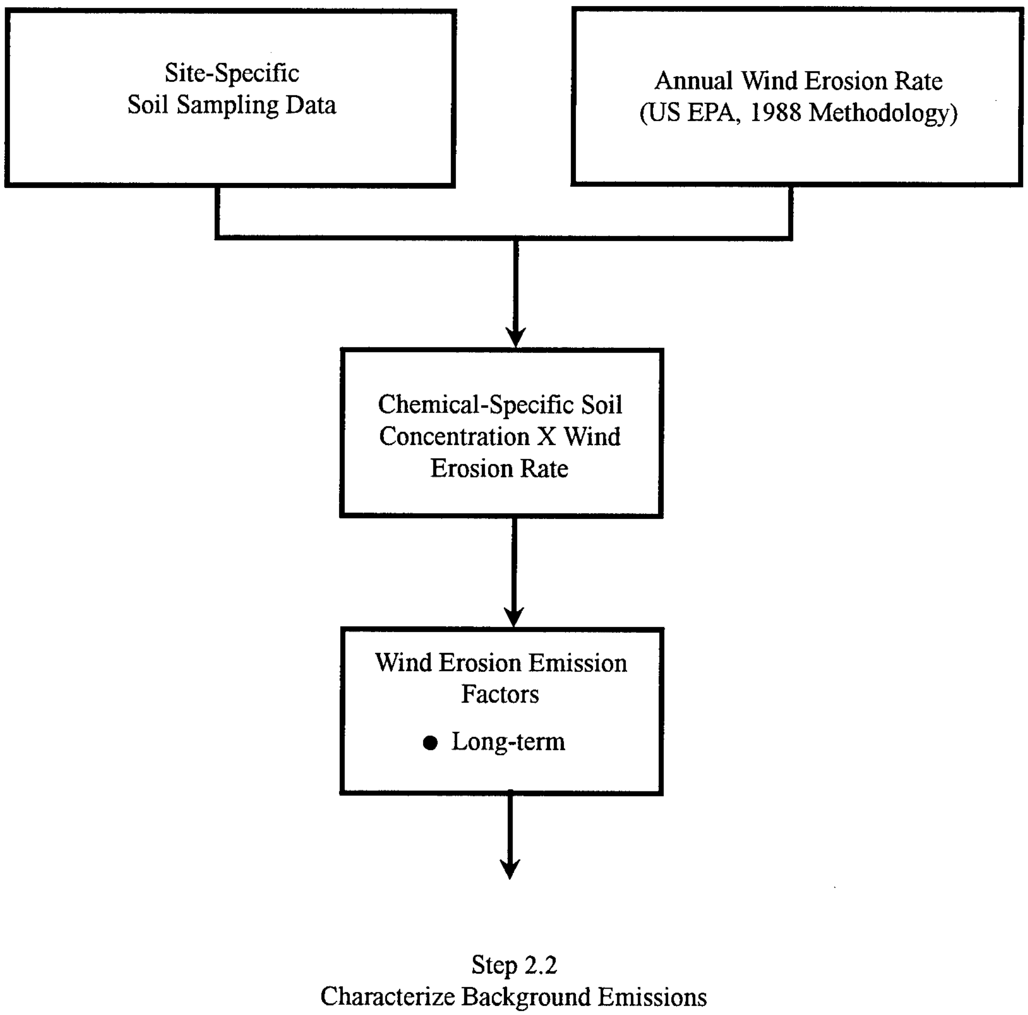


Fig. 4.1.3-1. Step 2.1.3: Evaluate posttreatment emissions.

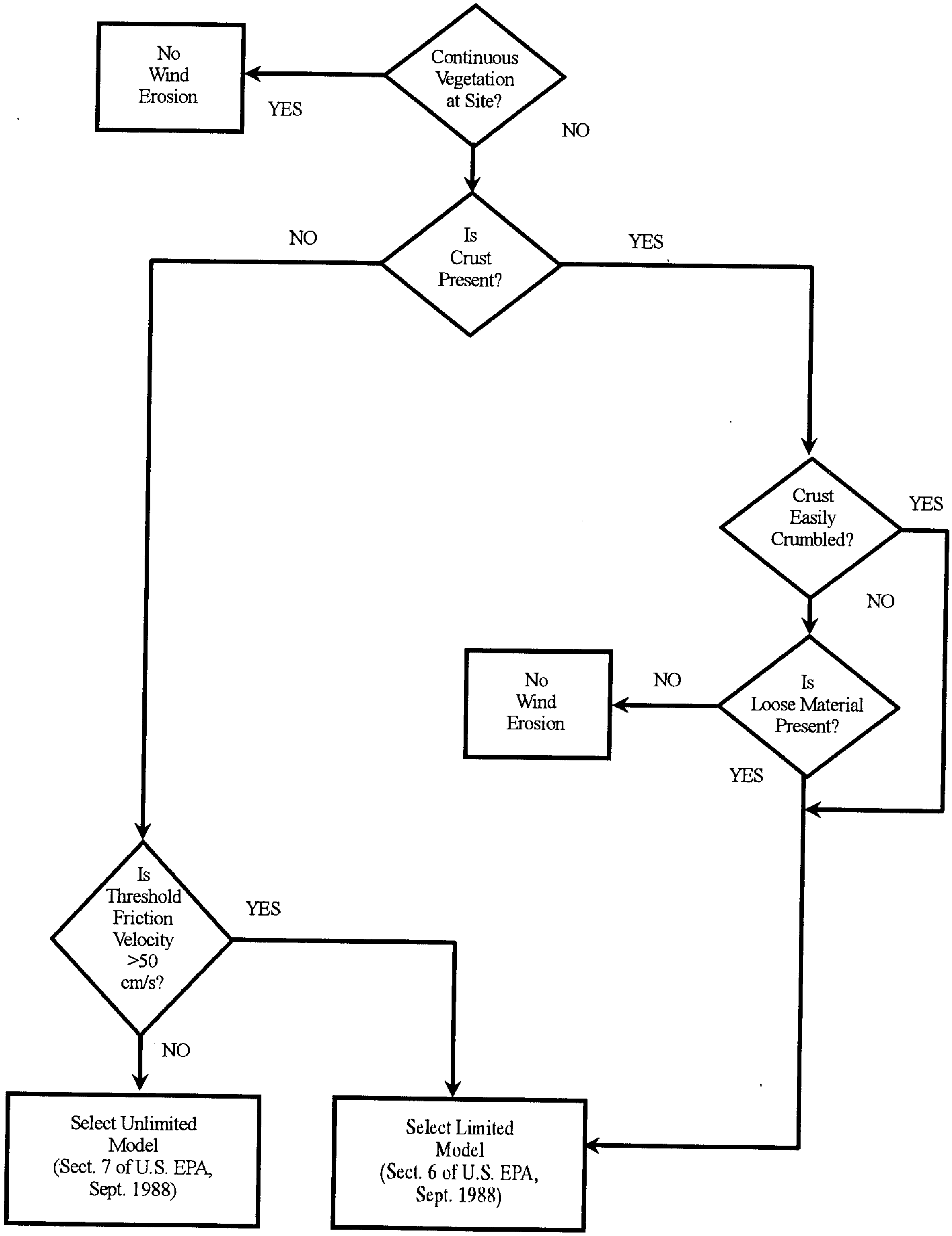


Fig. 4.1.3-2. Selection of the appropriate wind erosion emission model (based on methodology presented in Sections 6 and 7 of <u>Control of Open Fugitive Dust Sources</u> [U.S. EPA, September 1988]) based on Step 2.1.

two basic requirements for wind erosion are that the surface be dry and that it be exposed to the wind. For example, if the contaminated site lies in a swampy area or is covered by unbroken grass, the potential for wind erosion is virtually nil. If, on the other hand, the vegetative cover is not continuous over the exposed surface, the plants are considered to be nonerodible elements which absorb a fraction of the wind stress that otherwise acts to suspend the intervening soil.

For estimating emissions from wind erosion, either of two emission factor equations is recommended, depending on the erodibility of the surface material. Based on the site survey, the exposed surface must be placed in one of two erodibility classes described below. The division between these classes is best defined in terms of the threshold wind speed for the onset of wind erosion.

Nonhomogeneous surfaces impregnated with nonerodible elements (stones, clumps of vegetation, etc.) are characterized by the finite availability ("limited reservoir") of erodible material. Such surfaces have high threshold wind speeds for wind erosion, and particulate emission rates tend to decay rapidly during erosion. On the other hand, bare surfaces of finely divided material such as sandy agricultural soil are characterized by an "unlimited reservoir" of erodible particles. Such surfaces have low threshold wind speeds for wind erosion, and particulate emission rates are relatively time independent at a given wind speed.

For surface areas not covered by continuous vegetation, the classification of surface material as having either a "limited reservoir" or an "unlimited reservoir" of erodible surface particles is determined by estimating the threshold friction velocity. Based on analysis of wind erosion research, the dividing line for the two erodibility classes is a threshold friction velocity of about 50 cm/s. This somewhat arbitrary division is based on the observation that highly erodible surfaces, usually corresponding to sandy surface soils that are fairly deep, have threshold friction velocities below 50 cm/s. Surfaces with friction velocities larger than 50 cm/s tend to be composed of aggregates too large to be eroded mixed in with a small amount of erodible material or of crusts that are resistant to erosion.

The cutoff friction velocity of 50 cm/s corresponds to an ambient wind speed of about 7 m/s, measured at a height of about 7 m. In turn, a specific value of threshold friction velocity for the erodible surface is needed for either wind erosion emission factor equation (model).

Crusted surfaces are regarded as having a "limited reservoir" of erodible particles. Crust thickness and strength should be examined during the site inspection, by testing with a pocket knife. If the crust is more than 0.6 cm thick and does not easily crumble between the fingers, the soil may be considered nonerodible. If the crust thickness is less than 0.6 cm or crumbles easily, the surface should be treated as having a limited reservoir of erodible particles. If a crust is found beneath a loose deposit, the amount of this loose deposit, which constitutes the limited erosion reservoir, should be carefully estimated.

For encrusted surfaces, the threshold friction velocity is best estimated from the dry aggregate structure of the soil. A simple hand-sieving test of surface soil is highly desirable to determine the mode of the surface aggregate size distribution by inspection of relative sieve catch amounts, following the procedure specified in Section 6 of the Control of Open Fugitive Dust Sources (U.S. EPA, September 1988). The threshold friction velocity for erosion can be

determined from the mode of the aggregate size distribution, following a relationship as shown in Section 6 of that same document (U.S. EPA, September 1988).

Loose, sandy soils fall into the high-erodibility ("unlimited reservoir") classification. These soils do not promote crust formation, and show only a brief effect of moisture addition by rainfall. On the other hand, compacted soils with a tendency for crust formation fall into the low ("limited reservoir") erodibility group. Clay content in soil, which tends to promote crust formation, is evident from crack formation upon drying.

The annual wind erosion emission rate should be multiplied by the soil contamination concentration to determine contaminant-specific emission rates, as follows:

$$WE_i = \frac{(WE_s)(SC_i)(A)}{(3.15E7)(1.0E6)} \qquad \text{Eq. 4.1.3-1}$$

where

WE_i	=	annual wind erosion emission rate for contaminant "i" (g/sec)
WE_s	=	annual wind erosion emission rate for soil (g/m^2)
SC_i	=	soil contamination concentration for contaminant "i" (µg/g)
A	=	area of contaminated surface (m^2)
3.15E7	=	number of seconds per year (sec)
1.0E6	=	number of µg per g (µg/g)

The WE_i emission rate should be used as input for the wind erosion dispersion model as discussed in Section 6.3.

4.2 STEP 2.2: CHARACTERIZE BACKGROUND EMISSIONS

Background air emission sources also need to be evaluated considering the following (see Fig. 4.2-1):

- Regional air quality (Step 2.2.1)
- Installation point sources (Step 2.2.2)
- Military training and testing (Step 2.2.3)

These emission sources are discussed in Sections 4.2.1 through 4.2.3).

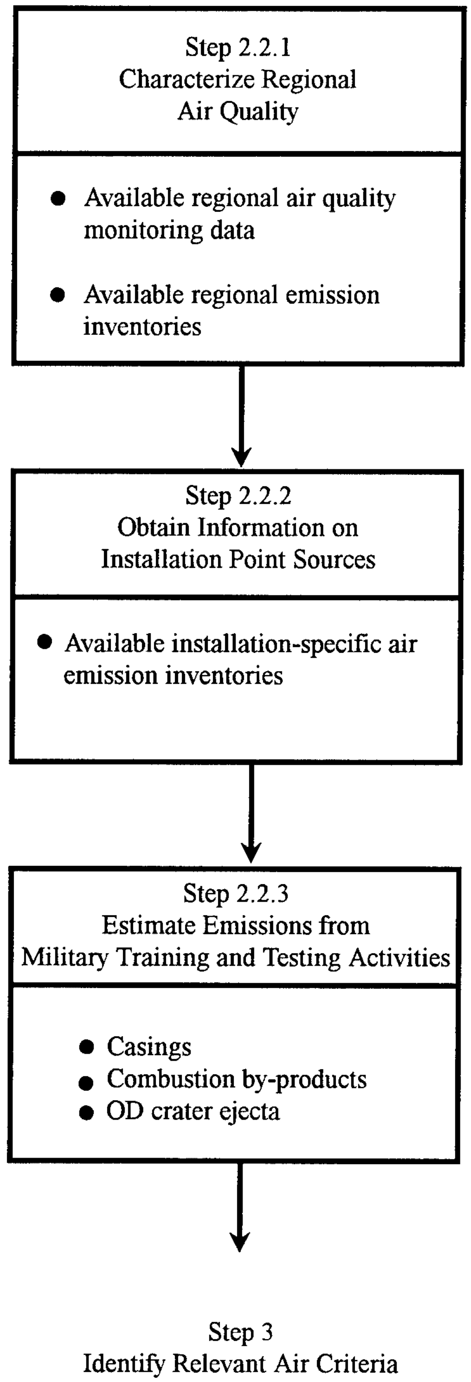


Fig. 4.2-1. Step 2.2: Estimate background emissions.

4.2.1 Step 2.2.1: Characterize Regional Air Quality

Regional source emissions inventories and air quality monitoring summaries are generally available from the appropriate state and local regulatory agencies. These data will need to be evaluated to determine applicability and significance for evaluating the acceptability of OB/OD plus background impacts.

4.2.2 Step 2.2.2: Obtain Information on Installation Point Sources

Major air pollution sources at the installation of interest should be identified. Many installations have recently completed comprehensive air emission inventories to fulfill requirements for implementation of the Clean Air Act Amendments of 1990. These data will need to be evaluated to determine their significance for evaluating the acceptability of OB/OD plus background impacts.

4.2.3 Step 2.2.3: Estimate Emissions from Military Training and Testing Activities

Military training and testing involving munitions and ordnance can be a major activity at an installation. The quantities of energetic material items for both training and testing can significantly exceed OB/OD treatment quantities. Since the emission contaminants are similar, it is particularly important to evaluate potential emissions from military training and testing sources.

Information needed to characterize military training and testing sources include the total NEW used and the portion associated with small arms ammunition and other items which do not cause cratering emissions. The location of these activities, considering proximity to the OB/OD unit and receptors of interest, also needs to be evaluated.

The same approach to determine OB/OD treatment emission factors should be used to estimate the following source contributions:

- Casings
- Combustion by-products
- Crater ejecta

This can generally be accomplished by scaling the emission factors for OB/OD treatment considering the ratio of training/testing NEW to OB/OD NEW. The scaling is directly applicable to long-term emission factors. For short-term emissions, however, the testing/training activities generally occur over a longer period of time, compared to relatively infrequent OB/OD events.

5.0 STEP 3: IDENTIFY RELEVANT AIR CRITERIA

Health and environmental criteria are needed to evaluate the potential impacts to OB/OD air emissions. The following two-step process should be used to identify relevant air criteria (as illustrated in Fig. 5.0-1).

- Step 3.1: Determine U.S. EPA Health and Environmental Air Criteria
- Step 3.2: Determine State and Local ARARs

These two steps are discussed in Sections 5.1 and 5.2, respectively.

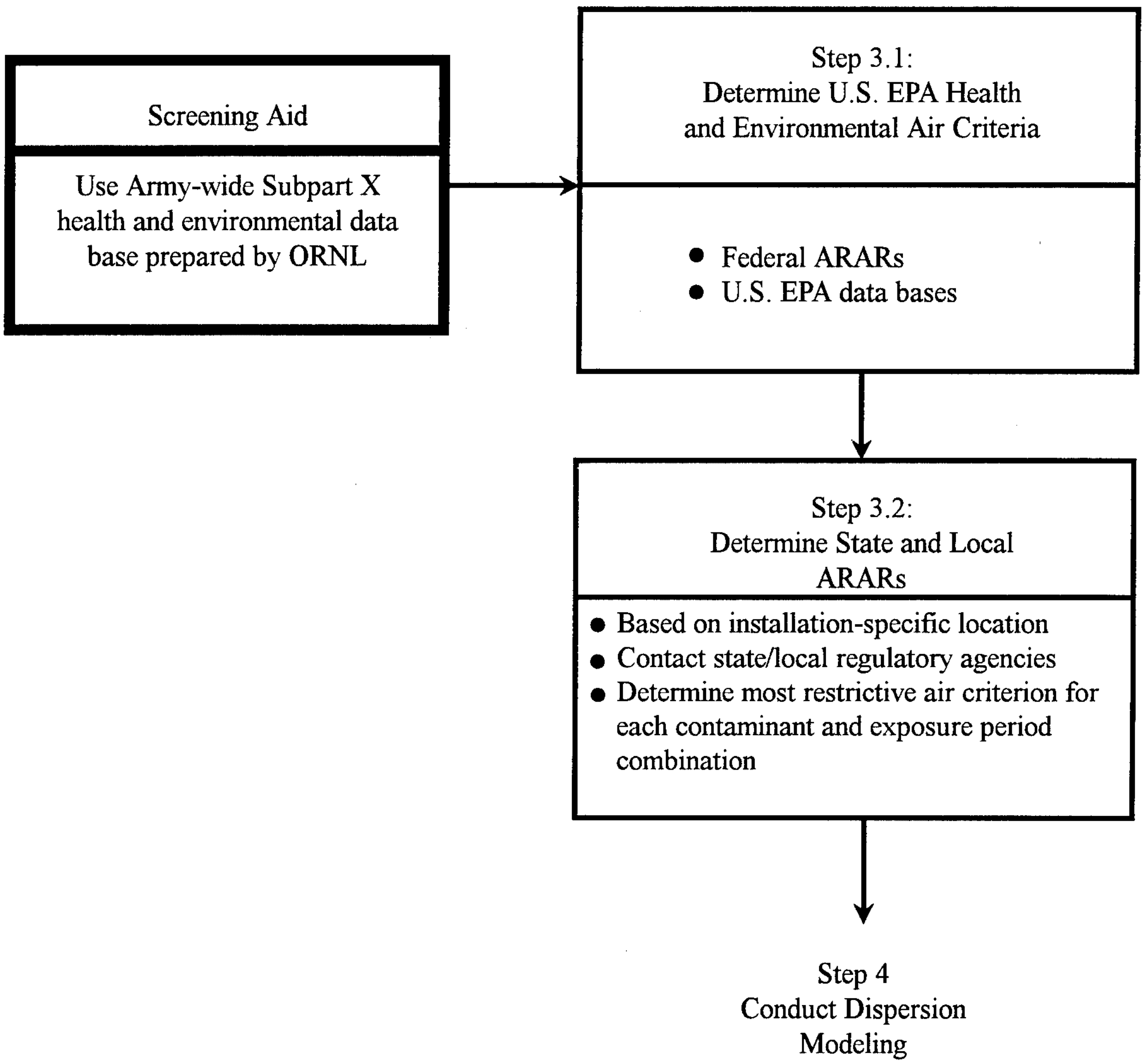


Fig. 5.0-1. Step 3: Identify relevant air criteria

5.1 STEP 3.1: DETERMINE U.S. EPA HEALTH AND ENVIRONMENTAL AIR CRITERIA

The first step in identifying relevant air criteria for OB/OD units is to evaluate U.S. EPA health and environmental air criteria. This involves consideration of Federal applicable or relevant and appropriate (regulatory) requirements (ARARs) as well as U.S. EPA health and environmental air criteria data bases.

The Oak Ridge National Laboratory (ORNL) has comprehensive capabilities and experience in preparing health criteria data bases and in the assessment of ARARs. ORNL is available to provide these services for Subpart X permitting assignments. Currently ORNL is providing health criteria and ARAR support to the Installation Restoration Program (IRP) of AEC as well as to other DOD and Government clients. For example, ORNL is developing a DOD-wide health criteria data base, is preparing health advisories, and has conducted ARAR assessments for numerous U.S. Army installations. ORNL also developed a Desk Guide to ARARs (issued in 1989 and updated in 1990) for AEC.

ORNL is also helping AEC to establish and routinely update an Army-wide health and environmental criteria data base specifically to support Subpart X permitting activities. This data base includes criteria for potential inhalation exposures (air) as well as ingestion (soil and water). Example excerpts from the ORNL data base are presented in Appendix E-1.

The ORNL data base includes the following information for potential OB/OD emission contaminants:

- Chronic criteria
    - + Toxicants
        - Reference doses
        - Reference concentrations
    - + Carcinogens
        - Risk-specific doses
        - Risk-specific concentrations
        - Acceptable risk
        - Unit cancer risk
        - Cancer slope factor
- Acute criteria
    - + Toxicity profiles

- Target organs/endpoints

The information sources for the ORNL data base include the following:

- Integrated Risk Information Systems, or IRIS (EPA)
- Health Effects Assessment Summary Tables (EPA)
- Health and Environmental Effects Documents (EPA)
- Health Advisories (EPA/DOD)
- Health Assessment Documents (EPA)

- Health Effects Assessments (EPA)
- Health and Environmental Effects Profiles (EPA)
- Federal ARARs (EPA)
- Occupational Health and Safety Standards (OSHA, NIOSH, and ACGIH).

Occupational health and safety standards have been included in the Subpart X data base in the context that they should be applied only at or within the installation boundary and may frequently represent minimal standards to protect the public and are useful in the absence of other health criteria.

At times, ingestion reference doses are reported by EPA et al. for contaminants of concern but not for the inhalation pathway. For these cases it may be useful for screening purposes to calculate reference doses and concentrations for inhalation.

In addition, the ORNL has developed a data base of screening benchmarks for ecological risk assessments (ORNL, June 1994; ORNL, July 1994; ORNL, September, 1994a; ORNL, September 1994b; ORNL, December 1994).

The most restrictive Army-wide air criteria based on the ORNL data bases and available supplemental data should be identified for each of the following standard periods.

- 1-min (ceiling)
- 15-min
- 1-hr
- 3-hr
- 8-hr
- 10-hr
- 24-hr
- Quarterly
- Annual (toxics)
- Annual (cancer)

The ORNL data base, however, should be supplemented based on evaluation of state and local ARARs as discussed in Section 5.2.

The Army has tasked the Chemical Hazard Evaluation Group of the ORNL to compile and summarize information applicable to OB/OD impacts associated with secondary pathways/indirect receptors/ecological receptors. This study will also involve preparation of a data base of environmental mobility and fate factors as well as environmental impact criteria for primary potential emission constituents. This information will be obtained on an installation-specific basis for contaminants of greatest concern as determined from sampling results. Approximately 10 contaminants should be selected for detailed evaluation at an installation (considering such factors as prevalence as well as toxicity). Available data are presented in Appendix E-2.

5.2 STEP 3.2: DETERMINE STATE AND LOCAL ARARs

Installation-specific ARAR assessments are needed for Subpart X air pathway assessments. State and local air quality standards as well as air toxic criteria can vary significantly from Federal requirements and therefore must be carefully evaluated for appropriateness and applicability for each installation. This is particularly important, since the air toxics criteria may not adequately address instantaneous and semi-instantaneous sources such as OB/OD units.

A first step in the determination of state and local ARARs is to determine the availability of ARAR documents prepared by ORNL for specific installations (see Table 5.2-1). However, it is still advisable to contact the appropriate air quality regulatory agency for the installation of interest to obtain the latest information.

The air criteria based on state and local ARARs should be compared to the criteria identified in Section 5.1 to determine the most restrictive air criterion for each combination of emission contaminant and exposure period.

Table 5.2-1. ARAR documents prepared by ORNL for U.S. Army installations

Fort A.P. Hill, Virginia
Letterkenny Army Depot, Pennsylvania
Lone Star Army Ammunition Plant, Texas
Anniston Army Depot, Alabama
Sharpe Army Depot Activity, California
Savanna Army Depot Activity, Illinois
Joliet Army Ammunition Plant, Illinois
Milan Army Ammunition Plant, Tennessee
Alabama Army Ammunition Plant, Alabama
Fort Dix, New Jersey
Cornhusker Army Ammunition Plant, Nebraska
Riverbank Army Ammunition Plant, California
Umatilla Depot Activity, Explosive Washout Lagoons, Oregon
Louisiana Army Ammunition Plant, Louisiana
Lake City Army Ammunition Plant, Missouri
Umatilla Depot Activity, Oregon
Volunteer Army Ammunition Plant, Tennessee
Tooele Army Depot, Utah
Fort Devens, Massachusetts
Sierra Army Depot, California
Twin Cities Army Ammunition Plant, Minnesota

6.0 STEP 4: CONDUCT DISPERSION MODELING

An air quality dispersion modeling study should be conducted to evaluate the potential impacts associated with OB/OD treatment emissions. The dispersion modeling study should be conducted in conformance with the following standard U.S. EPA guidance:

- Guidance on Air Quality Models (Revised), (U.S. EPA, 1986a; U.S. EPA, 1987; U.S. EPA, 1993).
- Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised (U.S. EPA, October 1992).
- User's Guide to CTDMPLUS: Volume 2. The Screening Mode (CTSCREEN) (U.S. EPA, 1990).
- INPUFF 2.0 (2.3) -- A Multiple Source Gaussian Puff Dispersion Algorithm User's Guide, (U.S. EPA, 1986b).
- User's Guide for the Industrial Source Complex (ISC2) Dispersion Models, Volume I - User Instructions (U.S. EPA, March 1992) (for treatment events of 1 hr or longer).

The objective of the study is to use the most representative dispersion model to estimate the worst-case exposure at the points of compliance. This includes the following steps (as illustrated in Fig. 6.0-1):

- Step 4.1: Specify meteorological parameters
- Step 4.2: Identify potential receptor locations
- Step 4.3: Model wind erosion area sources
- Step 4.4: Specify source release scenarios
- Step 4.5: Select and apply dispersion models
- Step 4.6: Adjust dispersion factors for exposure periods
- Step 4.7: Compute exposure concentrations
- Step 4.8: Compute deposition quantities

These steps are discussed in Sections 6.1 through 6.8.

Step 4.1
Specify Meteorological Parameters

- Allowable Army-wide meteorological conditions for OB/OD
- Installation-specific data
- Representative offsite data

↓

Step 4.2
Identify Potential Receptor Locations

- Point of Compliance (POC) receptors (16 sectors)
- Special receptors

↓

Step 4.3
Model Wind Erosion Area Sources

- Determine dispersion factors
- Compute air concentrations at POC
- Compare results to health criteria

↓

Step 4.4
Specify Source Release Scenarios

- OB modeling input parameters
- OD modeling input parameters

↓

Step 4.5
Select and Apply Dispersion Models

- Select dispersion model
- Determine dispersion factors
- Account for terrain

↓

Step 4.6
Adjust Dispersion Factors for Exposure Periods

- Exposure periods of 1 min, 15 min, 1 hr, 3hr, 8 hr, 24 hr, quarterly and annual
- Apply standard algorithm

↓

Step 4.7
Compute Exposure Concentrations

- OB/OD
- Background
- OB/OD and background

↓

Step 4.8
Compute Deposition Quantities

- Use exposure concentrations as input
- Use default deposition velocity

↓

Step 5
Evaluate Air Pathway Impacts

Fig. 6.0-1. Step 4: Conduct dispersion modeling

6.1 STEP 4.1: SPECIFY METEOROLOGICAL PARAMETERS

Meteorological parameters and scenarios should be specified to support OB/OD dispersion modeling (see Fig. 6.1-1). Meteorological conditions for air pathway modeling purposes should be assumed to be consistent with limitations specified for OB/OD operations within U.S. Army Material Command Regulation (AMCR) 755-8 (U.S. Army, 1988) commensurate with best OB/OD management practice on an Army-wide basis. In summary, this Army regulation limits OB/OD operations to the daytime hours associated with moderate wind speeds and unstable/neutral atmospheric conditions (refer to Table 6.1-1) as well as to any applicable state and local restrictions. Installation-specific SOPs may further limit allowable meteorological conditions for OB/OD operations.

A summary of installation-specific meteorological data needed for air pathway screening assessments is presented in Table 6.1-2. Onsite or representative offsite data should be used as available. A brief description of the application of these meteorological data for Subpart X screening assessments is also included in Table 6.1-2.

The dispersion modeling approach selected has been based on recommended U.S. EPA screening procedures. Therefore, worst-case meteorological conditions (within the range of OB/OD operating conditions discussed above) should be assumed for OB/OD treatment events which are less than 1 hr in duration. Wind direction conditions should be considered invariant for short-term exposures (24 hrs or less), and should take into account the prevailing wind direction (seasonal or annual) frequency for long-term exposure periods associated with OB/OD release events.

Sequential hourly data files (needed for the ISCST2 model) from a representative meteorological station should be used, as available, for OB releases which are greater than or equal to 1 hr in duration. These data may have to be edited to remove any nonallowable meteorological conditions from the historical data files.

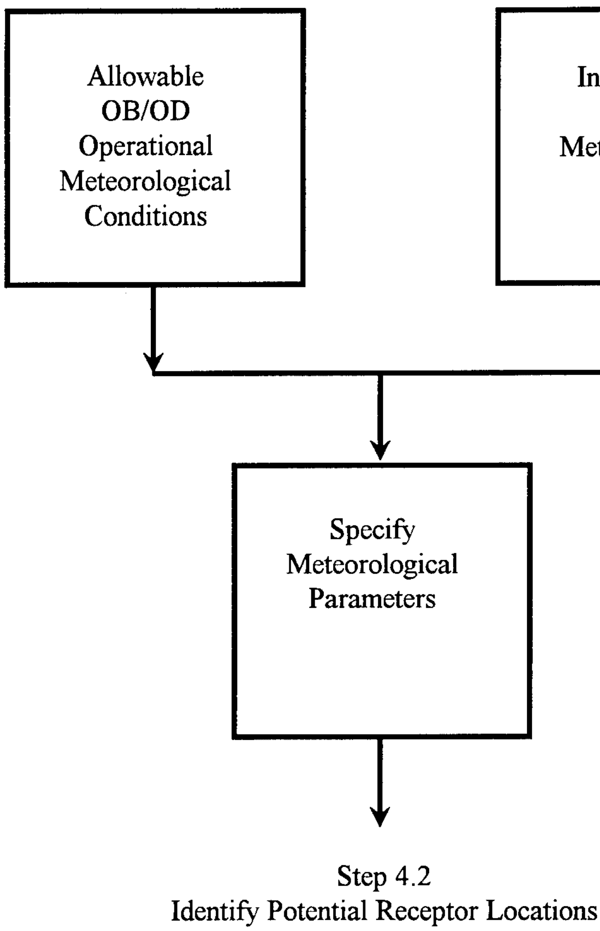


Fig. 6.1-1. Step 4.1: Specify meteorological parameters.

Table 6.1-1. Allowable OB/OD Army-wide meteorological conditions

Parameters	Assumptions
Wind speed	Greater than 3 mph (1.3 m/s) and less than 20 mph (8.9 m/s)
Stability	Non-inversion (stability classes A-D) conditions
Precipitation	None

Table 6.1-2. Installation-specific meteorological data needed for air pathway screening assessments

Parameters	Application
EPA wind speed criteria for allowable stability conditions: • A stability (1.3-3.0 m/s) • B stability (1.3-5.0 m/s) • C stability (1.3-8.9 m/s) • D stability (1.3-8.9 m/s)	Used to determine worst-case dispersion conditions for OB/OD
Annual prevailing wind direction frequency (as a fraction from 0.0 to 1.0)	Used to adjust annual modeling results based on an invariant wind direction assumption
Maximum seasonal prevailing wind direction frequency (as a fraction from 0.0 to 1.0)	Used to adjust seasonal modeling results based on an invariant wind direction assumption
Annual mean wind speed	Used to determine annual dispersion conditions for wind erosion assessment. Also used for calculating annual concentrations for "limited" wind erosion emissions
Annual precipitation-evaporation index (PE)	Used for calculating "unlimited" wind erosion emission rate
Fastest 1-mile wind speed	Used for calculating "limited" wind erosion emission rate
Ambient air temperature	Used to calculate OB/OD cloud height
Annual average mixing height	Used to limit vertical dispersion

6.2 STEP 4.2: IDENTIFY POTENTIAL RECEPTOR LOCATIONS

Modeling receptor locations should at a minimum include all of the Points of Compliance (POC). Supplemental modeling receptors (i.e., a comprehensive receptor array based on standard U.S. EPA modeling protocols) may be needed in some cases to determine the maximum concentration location and magnitude. The Subpart X Position Paper states that for the air pathway the POC is defined as actual receptors within the unit boundary or at the installation boundary (whichever is closest). The POC should be evaluated for each of 16 sectors (22.5 degrees each, corresponding to cardinal compass points). For OB/OD releases associated with a cloud height, it is necessary to confirm that the installation boundary represents the maximum offsite exposures. This can usually be accomplished by use of standard U.S. EPA screening model such as PTMAX, SCREEN2, and others, as well as INPUFF.

POC locations should be compiled into a summary table which includes information on distances from the OB/OD unit boundary to each receptor as well as terrain height information. An example format for presenting these data is shown in Table 6.2-1.

Similar information should be compiled for additional potential receptor locations and reference distances as identified in Fig. 6.2-1. Utilization of standard reference distances for dispersion modeling enables the estimation of any other potential receptor within 50-70 km (as limited by model performance) of the OB/OD unit.

Typically, receptor distances are measured from the edge of the OB/OD unit. However, for certain cases (especially if the active area for treatment within the unit does not vary), the distance from the center of the active treatment area may be justifiable.

Table 6.2-1. Point of Compliance locations – example format

Sector	Description	Distance from OB/OD unit boundary (km)	Terrain height (ft, MSL)
N	Installation boundary		
NNE	Installation boundary		
NE	Installation boundary		
ENE	Installation boundary		
E	Installation boundary		
ESE	Installation boundary		
SE	Installation boundary		
SSE	Installation boundary		
S	Installation boundary		
SSW	Installation boundary		
SW	Installation boundary		
WSW	Installation boundary		
W	Installation boundary		
WNW	Installation boundary		
NW	Installation boundary		
NNW	Installation boundary		

Installation boundary (POC) locations

- N
- NNE
- NE
- ENE
- E
- ESE
- SE
- SSE
- S
- SSW
- SW
- WSW
- W
- WNW
- NW
- NNW

Reference downwind distances (km)

0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
2.0
5.0
7.0
10.0
20.0
50.0
70.0

Nearest human receptors

- EOD bunker
  (On-base worker, temporary)
- Bivouac (temporary)
- On-base worker (permanent)
- On-base resident
- Off-base resident
- Hospital
- School
- Day care facility
- Retirement home
- Religious center
- Youth center
- Prison
- Public access road
- Population center

Nearest environmental receptors

- Wetland
- Open water
- Agricultural field
- Farm/ranch
- Hunting area
- Endangered species
- Wildlife management area
- Federal/state forest
- Park lands
- Wildlife food and cover strips
- Gardens
- Site-specific areas of concern
  (e.g., sensitive or rare species)

→ Step 4.3
Model Wind Erosion Area Sources

Fig. 6.2-1. Step 4.2: Identify potential receptor locations.

6.3 STEP 4.3: MODEL WIND EROSION AREA SOURCES

Wind erosion area sources should be modeled based on the process illustrated in Fig. 6.3-1. Dispersion rates associated with wind erosion of contaminated soil need to be modeled separately from OB/OD treatment emissions. For screening purposes the following conservative scenarios should be modeled:

- Ground-level area source
- Neutral stability "D" representative of typical wind erosion conditions
- Annual mean wind speed (for "unlimited" wind erosion conditions)
- Fastest 1-mile wind speed (for "limited" wind erosion conditions)
- Annual prevailing wind direction frequency
- Arbitary emission rate of 1 g/s (to facilitate scaling of results)

The SCREEN (U.S. EPA, 1988) model can be used to model the wind erosion source for screening assessments. An alternative model which can be used is ISC2 (U.S. EPA, March 1992). Dispersion factors for the above scenario based on a 1 g/s emission rate should be scaled as follows to estimate chemical-specific concentrations:

$$C_{WE_i} = \frac{(DF_{WE})\ (WE_i)}{\bar{u}} \qquad \text{Eq. 6.3-1}$$

where

C_{WE_i} = concentration of contaminant i due to wind erosion ($\mu g/m^3$)

DF_{WE} = wind erosion dispersion factor assuming an arbitrary emission rate of 1 g/s ($\mu g\ m^{-2}\ g^{-1}$)

WE_i = installation-specific annual wind erosion emission rate for contaminant i from Step 2.1 (g/s)

$\bar{u}$ = mean wind speed (m/s)

The results from Eq. 6.3-1 (annual contaminant-specific air concentrations at each receptor due to wind erosion) should be compared against the health and environmental criteria identified in Step 3. Additive effects of exposures to multiple contaminants should be accounted for and impacts evaluated pursuant to the guidance presented in Step 5.

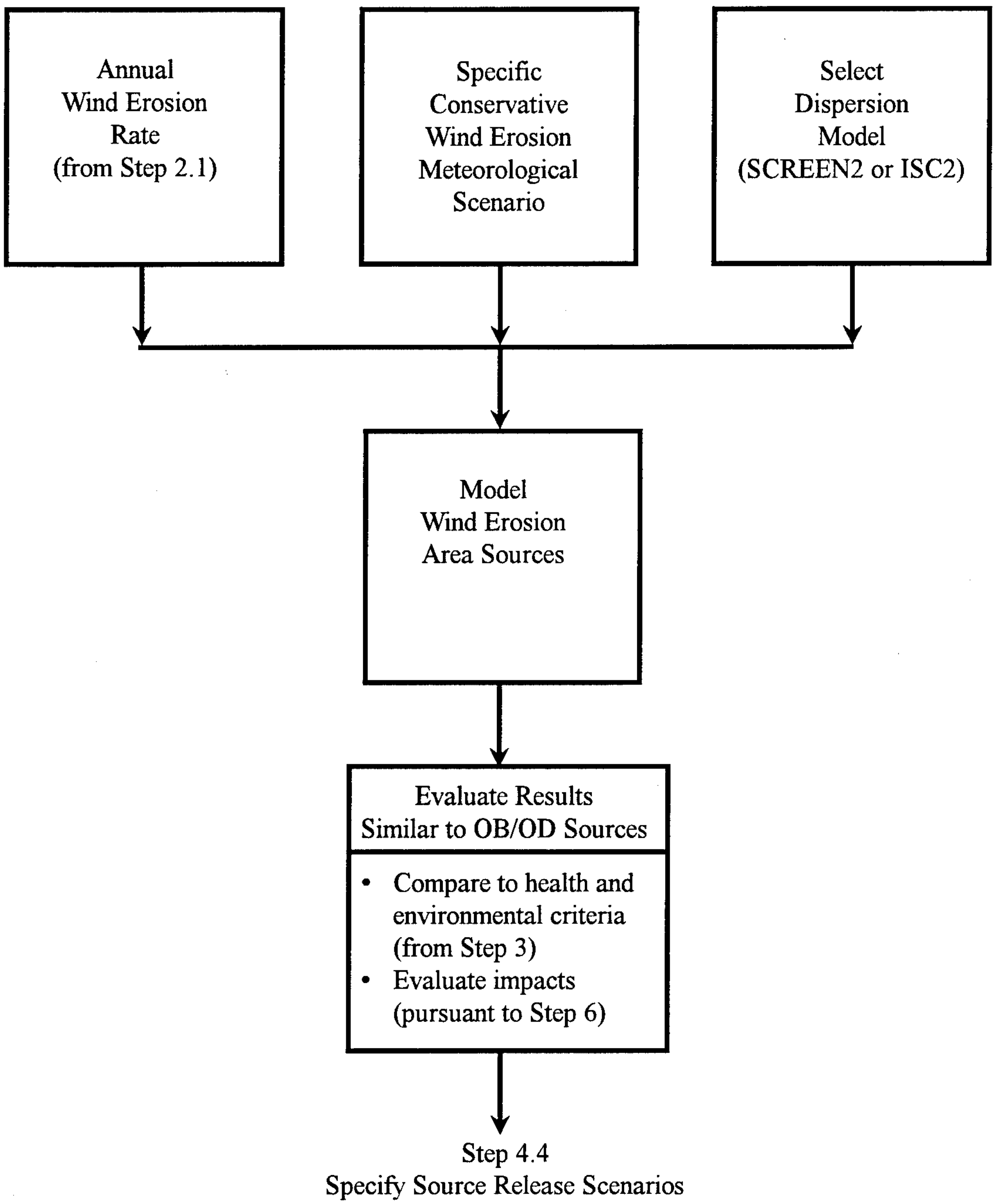


Fig. 6.3-1. Step 4.3: Model wind erosion area sources

6.4 STEP 4.4: SPECIFY SOURCE RELEASE SCENARIOS

Source release scenarios should be specified to define critical modeling input. Section 6.4.1 discusses the recommended approach for OB sources and Section 6.4.2 for OD sources (see Fig. 6.4-1).

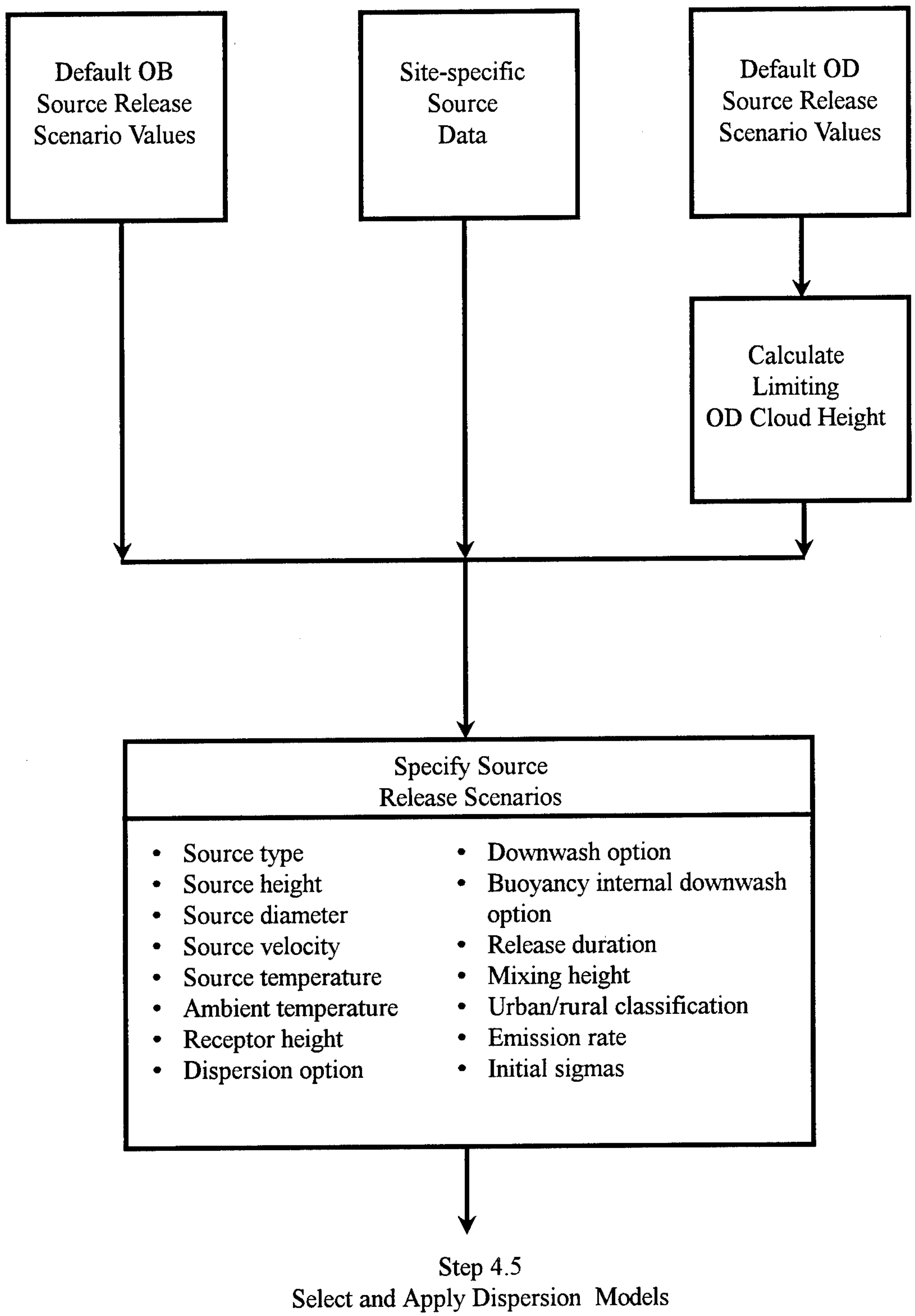


Fig. 6.4-1. Step 4.4: Specify source release scenarios.

6.4.1 OB Source Release Scenarios

Source release scenario assumptions for OB units are summarized in Table 6.4.1-1.

Air releases from OB operations can be characterized as intermittent or semi-instantaneous in nature. The duration of each OB operation typically ranges from seconds to minutes depending on the energetic materials being treated. Some OB cases, especially those using dunnage, may involve releases or smoldering, with durations of hours. The standard modeling approach for OB units is to assume that the total quantity of air contaminants, based on applicable emission factors or rates, is released within a 1-min period. Installation-specific information, however, should be used as available to specify the typical OB release duration.

The OB source scenario should be modeled as a point source. The stack height and diameter release parameters should be obtained from the height and dimensions of the burn pan. The assumed exit gas temperature corresponds with an average OB temperature, based on a review of POLU-11 OB modeling runs (see Appendix F-1). Values will vary depending on the material treated and the use of dunnage. A default OB temperature of 3,700K (6,208°F) is identified by the U.S. EPA in the RCRA Subpart X Unit Checklist. However, the basis for this value is unknown. The annual (average) temperature and mixing height are based on the climatological data. An exit velocity of 1.0 to 6.0 m/s should be assumed (as a default value) for the treatment of propellants (refer to Appendix F-1 for the basis for default exit velocities). Exit velocities for both energetic material and dunnage can be in the range of 0.1 to 3.0 m/s. The buoyancy-induced dispersion option should be selected in each model to estimate the plume rise of the OB cloud. If videotapes of OB events are available for the installation, they can provide an alternative approach to estimating OB exit velocities and/or cloud height. These observational data are particularly important if dunnage is used for OB treatment operations, since OB temperature and exit velocities may be less than for pure propellant burns, as previously indicated. Field observation (as discussed in Appendix F-1) indicates that burn durations for energetic materials did not significantly vary if dunnage was used. However, the burn time for the dunnage exceeded that for the energetics. Therefore, it may be appropriate to model the energetics and dunnage as two different source scenarios.

OB units are typically located in rural areas; therefore, the rural dispersion modeling option is generally warranted. Emission rates should be normalized to the equivalent of the total release of 1 lb within a 1-hr averaging period. This normalization facilitates scaling the resulting dispersion factors (in a later step) to account for contaminant-specific emission factor rates. Initial sigmas as standardly calculated by the dispersion models are generally considered appropriate.

Additional information on the basis for selecting OB default source terms is provided in Appendix F-1.

Table 6.4.1-1. OB modeling input parameters

Parameters	Approach
Source type	Point source
Source height (m)	Burn pan height (typically 0.5 m)
Source diameter (m)	Equivalent to diameter for area equal to burn pan size (default value typically 2.8 m)
Source velocity (m/s)	
● Propellants	1.0[a] - 6.0[b]
● Other energetic material items	0.1[a] - 3.0[b]
● Dunnage	0.2[a] - 3.0[b]
Source temperature (K)[c]	
● Propellants	1,000
● Other energetic material items	1,000
● Dunnage	700
Ambient air temperature (K)	Annual climatic average (293K default)
Receptor height above ground (m)	0.0 (ground-level receptor)
Dispersion option	Pasquill-Gifford
Downwash option	No
Buoyancy internal downwash option	Yes
Release duration(s)	60s (unless installation-specific information indicates otherwise)
Mixing height (m)	Annual climatic average
Urban/rural classification	Rural (dispersion)
Emission rate (g/s)	
● ISC2	0.126 (normalized to 1 lb in 1 hr)
● SCREEN2/CTSCREEN	0.126 (normalized to 1 lb in 1 hr)
● INPUFF[d]	Normalized to 1 lb in 1 hr
+ Release period	7.57 (0-60 s)
+ Non-release period	0.00 (>60 s)
Initial sigmas for INPUFF	
● Sigma Y (m)	Model calculated (point source)
● Sigma Z (m)	Model calculated (point source)

[a]Best estimates based on limited available OB field observations from Tooele (see Appendix F-1).
[b]Based on additional OB field studies as discussed in Appendix F-5. Use of low exit velocities is conservative (i.e., results in higher maximum ground-level concentrations).
[c]Averages based on POLU model (Baroody and Tominack, 1987) results for typical propellants (see Appendix F-1).
[d]Release duration of 1 hr or more may be warranted if dunnage used.

6.4.2 OD Source Release Scenarios

Source release scenario assumptions for OD units are summarized in Table 6.4.2-1.

Emission releases from OD events are considered as intermittent, instantaneous sources. For the screening modeling assessment, a 1-s release should be assumed. If the SCREEN2 model is used for preliminary screening purposes, the OD event should be simulated as a buoyant point source release due to the source initiation limitations of the model. Initially, the OD cloud can be considered as a ground-level volume source.

The high-explosive field results and algorithms developed by the Defense Nuclear Agency (DNA, October 1981) provides an approach for calculating OD stabilized cloud volume and height as a function of the net explosive weight of the detonation. Explosive field tests evaluated by DNA for detonations of 2,000 lb or less indicate that the stabilized height and volume of an OD cloud will be obtained within 2 min of detonation. This presents a problem in directly using the DNA cloud volume and height algorithms for characterizing initial source conditions. The OD cloud could travel 100 to 1,000 m (depending on wind conditions) before the DNA methodology is directly applicable. Another complication is that the OD cloud height algorithm does not include parameters for wind speed, atmospheric stability and lapse rate.

An alternate approach for characterizing initial OD source conditions has been identified. This approach involves specifying initial source volume (based on using POLU modeling results of total gases produced during detonation) and allowing the dispersion model to calculate plume rise. Thus, the initial OD cloud is assumed initially to be a ground-level volume (cylinder) source. Following is an overview of this approach.

The horizontal and vertical dispersion parameters (sigma y and sigma z) should be initialized based on the assumed cloud dimensions using standard U.S. EPA methods as referenced in Table 6.4.2-1.

The stabilized OD cloud height can be estimated using the following DNA equation:

$$H_{CT} = (508)(W')^{0.25} \qquad \text{Eq. 6.4.2-1}$$

where

H_{CT} = stabilized cloud top height (m)

W' = TNT-equivalent explosive weight (tons)

Table 6.4.2-1. OD modeling input parameters

Parameter	Approach
Source type	Volume
Source height (m)	0.0 (ground level)
Source diameter (m)	Initial cloud (crater) diameter[a]
Source velocity (m/s)	Estimated (generally within range of 0.1 to 10 m/s) to produce cloud height results consistent with OD field tests
Source temperature (K)	800 (default)[b]
Ambient air temperature (K)	Annual climatic average
Receptor height above ground (m)	0.0 (ground-level receptor)
Dispersion option	Pasquill-Gifford
Downwash option	No
Buoyancy Internal Downwash option	No
Release duration (s)	1
Mixing height (m)	Annual climatic average
Urban/rural classification	Rural (dispersion)
Emission rate (g/s)	
• ISC	0.126 (normalized to 1 lb in 1 hr)
• SCREEN/CTSCREEN	0.126 (normalized to 1 lb in 1 hr)
• INPUFF	Normalized to 1 lb in 1 hr
+ Release period	454 (0-1 s)
+ Non-release period	0.00 (>1 s)
Initial sigmas for INPUFF[c,d]	
• Sigma Y (m)	Initial cloud (crater) diameter ÷ 4.3
• Sigma Z (m)	Initial cloud (source) top height ÷ 2.15

[a]Cloud diameter based on volume of total gases released (14.7 psi) based on POLU modeling (e.g., C-4). See Appendix F-2.1.

[b]Average based on POLU model results for C-4 (see Appendix F-2).

[c]Division factors of 4.3 for σ_y based on volume source and 2.15 for σ_z based on surface-based source, as discussed in the ISC User's Guide (U.S. EPA, March 1992).

[d]See Appendix F-2.1.

Based on the DNA approach, the OD stabilized cloud center height can be estimated as follows:

$$H_{CC} = (0.75)(H_{CT}) \qquad \text{Eq. 6.4.2-2}$$

where

H_{CC} = stabilized cloud center height (m)

The DNA (October 1981) algorithm for the stabilized OD cloud height has been based on a study conducted by Church (May 1969). This DNA material is presented in Appendix F-2.4 and the Church document in F-2.5. This involved an evaluation of 23 surface detonations. Quantities detonated ranged from 118 to 2,800 lbs net explosive weight (NEW). Average meteorological conditions during the detonation tests were slightly stable (i.e., "E" stability, corresponding to an average lapse rate of 0.2°C/100 m) and moderate wind speeds (i.e., 5.6 m/s average).

The DNA stabilized OD cloud height should be used to select the appropriate OD exit velocity to calibrate the cloud height calculations of the dispersion model. This is accomplished by multiple preliminary screening dispersion modeling scenarios for hypothetical exit velocities ranging from 0.1 to 10 m/s. The meteorological conditions for these scenarios should correspond to the average DNA field test conditions (i.e., "E" stability and a 5.6 m/s wind speed). Based on these modeling results, an exit velocity should be selected which results in an OD stabilized cloud center height that is less than or equal to the DNA value determined from Eq. 6.4.2-2 (i.e., for the meteorological/modeling scenario which best simulates the DNA test conditions). The selected exit velocity should be used for subsequent screening assessments.

Cloud heights for OD tests were observed to stabilize approximately 2 minutes after the denotations. Typically, based on the average of all tests, the interim cloud height to stabilized cloud height ratio was 0.5 at 30 s after the detonation and 0.7 at 1 min. These results did not vary significantly as a function of atmospheric stability. A plot of cloud height versus time after detonation is presented in Appendix F-2.2. These adjustment factors should be used to reduce the cloud height for receptor distances less than those where the stabilized height is reached.

OD units are typically located in rural areas; therefore the rural dispersion option is generally warranted. Emission rates should be normalized to the equivalent of a total release within a 1-hr averaging period (although the release is 1 s in duration). This normalization facilitates scaling the resulting dispersion factors (in a later step) to account for contaminant-specific emission factors.

Complex terrain should be accounted for based on the approach discussed in Sections 6.5.1 and 6.5.2.

Additional information on the basis for selecting OD default source terms (Table 6.4.2-1) is provided in Appendix F-2. These methods are applicable to surface detonations. Installation-specific measurements or observations should be obtained to determine the cloud center height for subsurface detonations.

6.5 STEP 4.5: SELECT AND APPLY DISPERSION MODELS

Step 4.5 involves the following two steps, as illustrated in Fig. 6.5-1.

- Step 4.5.1: Conduct preliminary screening assessment
- Step 4.5.2: Select and apply screening dispersion models

These steps are discussed in Sections 6.5.1 and 6.5.2.

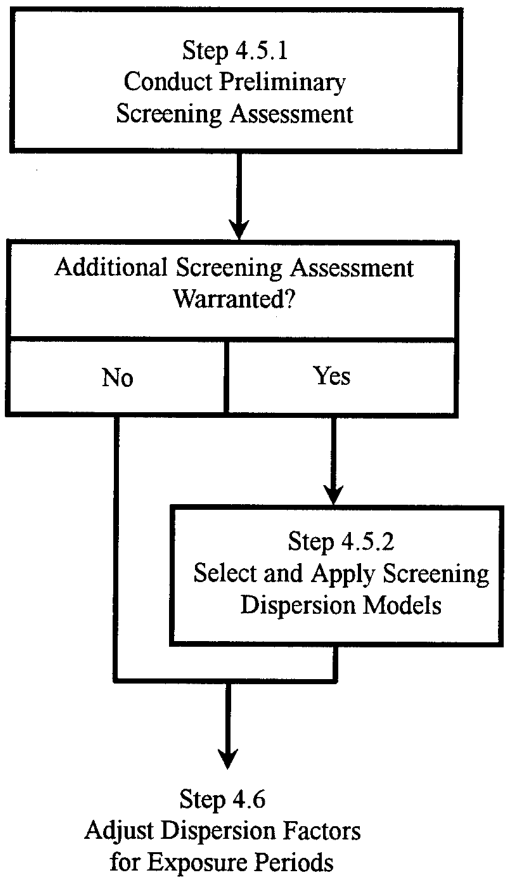


Fig. 6.5-1. Step 4.5: Select and apply dispersion models.

6.5.1 Step 4.5.1 Conduct Preliminary Screening Assessment

A synopsis of Step 4.5.1 is presented in Fig. 6.5.1-1.

The SCREEN2 model (U.S. EPA, October 1982), although only simulating continuous sources, can also be useful for evaluating OB/OD sources. For example, as discussed in Section 6.4.2, this model can be evaluated as a preliminary screening tool to select appropriate OD exit velocity values for subsequent modeling by INPUFF and for identifying cloud heights which are less than the stabilized OD cloud height value for receptors in proximity to the source. In addition, SCREEN can be used to obtain conservative estimates of concentration for instantaneous sources.

TSCREEN is an alternate screening model to SCREEN2 (U.S. EPA, August 1990). In particular, the SCREEN and PUFF options of TSCREEN may be useful for OB/OD sources. A comparison of SCREEN2 (nonflare) versus TSCREEN-SCREEN (nonflare) and TSCREEN-PUFF modeling results is presented in Appendix F-3. These data indicate the SCREEN2 and TSCREEN-SCREEN are identical. However, TSCREEN predicts significantly higher maximum concentrations.

A limited comparison of SCREEN2 results with INPUFF and ISC for 1-hr concentrations is presented in Appendix F-4. These results support the conclusion that SCREEN2 results are higher than those from INPUFF. Worst-case assumptions can also be employed to estimate concentrations for exposure periods less than 1 hr. This approach is based on assuming that the entire exposure to the cloud by the receptor occurs during the averaging period of interest. Therefore, the 1-min concentration equals the 1-hr concentration (based on SCREEN2) times 60. And the 15-min concentration is equivalent to the 1-hr concentration (based on SCREEN2) times a factor of 4. The conservatism of this approach is supported by the 1-min, 15-min, and 1-hr INPUFF data presented in Appendix F-4.

SCREEN2 modeling results, however, must be evaluated with caution. The SCREEN2 model may underestimate ground-level concentrations 100-1,000 m from the source. Maximum plume height is used for all receptor distances by SCREEN2, but the OB/OD cloud heights may be lower in this near-source regime. In addition, the full range of meteorological conditions evaluated by SCREEN2 include those during which OB/OD typically is not conducted. This may result in overestimates of impacts unless maximum concentrations as a function of downwind distance are manually compiled based on evaluating only OB/OD operational conditions.

TSCREEN maximum concentrations were significantly higher than both INPUFF and SCREEN2. No further evaluation to determine the reason for these differences was conducted. However, it is recommended that TSCREEN-PUFF be used only with extreme caution, and use of an alternative model (e.g., SCREEN2 or INPUFF) is recommended.

Simple and complex terrain can both be accounted for in a conservative manner using SCREEN2. Simple terrain refers to receptor heights which are less than or equal to cloud height. Receptors can be modeled by using actual terrain height (relative to the terrain height at the

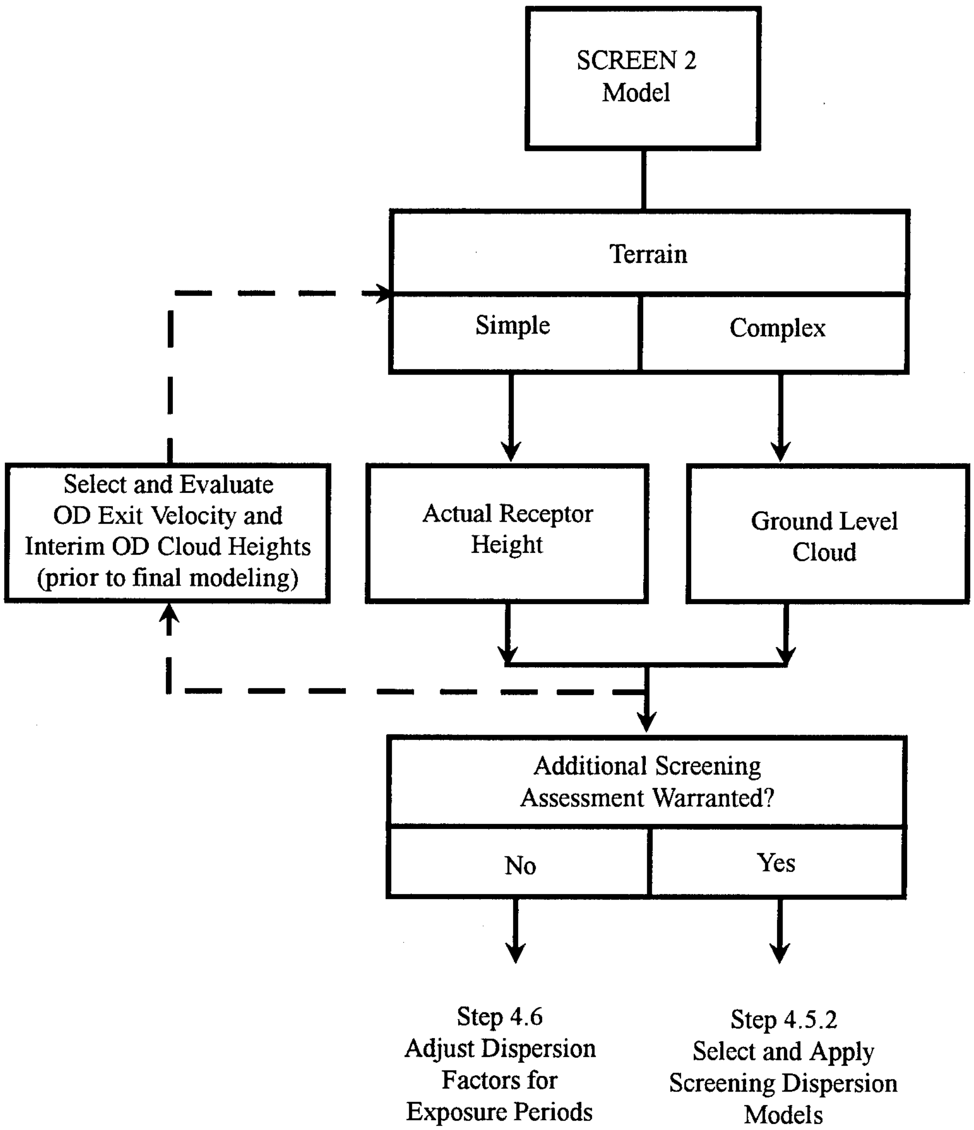


Fig. 6.5.1-1. Step 4.5.1: Conduct preliminary screening assessment.

source) as modeling input. Complex terrain is defined as terrain height at receptor locations which exceed cloud height at that location. These receptors can be conservatively modeled by assuming that both the cloud centerline and receptor are at the same height (typically both are assumed to be at ground level). Alternative suggestions for accounting for complex terrains using models other than SCREEN2 are addressed in Section 6.5.2.

6.5.2 Step 4.5.2: Select and Apply Screening Dispersion Models

Candidate screening dispersion models for OB/OD sources include the following:

- INPUFF
- ISC2
- CTSCREEN

The approach for selection of the appropriate dispersion model to simulate OB/OD releases is summarized in Fig. 6.5.2-1. The primary selection factors are release duration and terrain classification.

The INPUFF model should be used for release durations which are less than 1 hr per OB/OD event. One puff should be used to simulate instantaneous/semi-instantaneous releases which can be defined as release durations less than or equal to the cloud rise time. Multiple puffs should be used to simulate more realistically those scenarios where the release duration is greater than the cloud/plume rise time.

Complex terrain is defined as receptor heights greater than the cloud/plume center height for OB/OD air pathway assessments. For simple terrain scenarios the elevations of the release and receptor are input directly into the dispersion model to account for difference in terrain heights.

Adjustments to the INPUFF modeling scenarios should be made to account for complex terrain. This should be accomplished by assuming a ground-level cloud/plume center and ground-level receptors. The use of flagpole receptor heights above the cloud/plume center height is discouraged since they may not be representative of actual exposure conditions for many cases.

Another approach to account for complex terrain is the "half height" method presented in the Rough Terrain Diffusion Model (RTDM) (U.S. EPA, July 1987). For unstable and neutral conditions, the cloud/plume center is assumed to possess adequate kinetic energy to pass over terrain features. Accordingly, the adjustment to cloud/plume center height above terrain is as follows:

Eq. 6.5-1

$H_a = 0.5\,H_{cc}$ (if cloud height is less than or equal to receptor terrain height)

$H_a = Hcc - 0.5H_{ter}$ (if cloud height is greater than receptor terrain height)

where

H_a = adjusted cloud/plume center height

H_{cc} = cloud/plume center height based on simple terrain modeling

H_{ter} = receptor terrain height relative to OB/OD unit

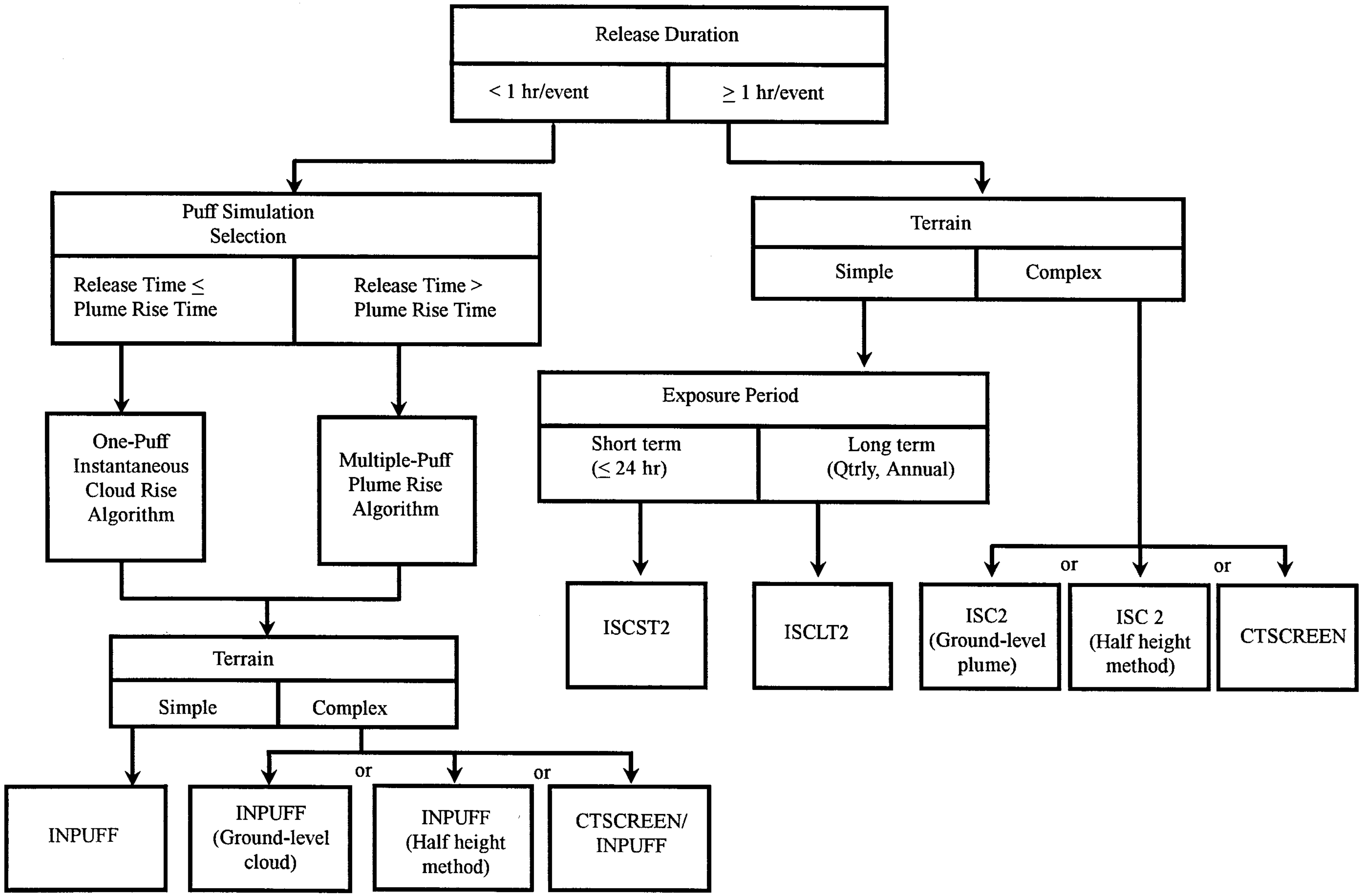


Fig. 6.5.2-1. Step 4.5.2: Select and apply screening dispersion models.

The cloud height is adjusted for the various wind speed/stability class combinations to determine worst-case concentrations for each receptor.

An alternative approach can be used for complex terrain cases with releases of less than 1 hr. This alternative approach involves adjusting INPUFF results (which accounts for the instantaneous/semi-instantaneous nature of the release) based on CTSCREEN and INPUFF results (which accounts for terrain factors). This approach is explained below.

The U.S. EPA dispersion model CTSCREEN is considered a more accurate model for complex terrain but does not adequately represent exposures of less than 1 hr for instantaneous/semi-instantaneous sources (such as OB/OD units). The U.S. EPA dispersion model INPUFF is considered a more appropriate model for instantaneous/semi-instantaneous sources to estimate exposure of 1 hr or less but does not adequately account for complex terrain. Therefore, a ground-level nonbuoyant release should be conservatively modeled (to simulate complex terrain impacts) using INPUFF (to account for the instantaneous/semi-instantaneous release behavior). However, this approach overestimates OB/OD impacts because it assumes that the cloud centerline was at ground level at the receptor. But CTSCREEN realistically assumes that the OB/OD release centerline does not reach the ground-level receptor at a complex terrain location. CTSCREEN assumes such a release rides up or around the terrain obstacle and does not directly intersect (impact) it during non-inversion conditions. Therefore, a combination of INPUFF and CTSCREEN is needed for a more realistic estimate of dispersion factors in complex terrain, as follows:

$$DF_{CT} = \left[\frac{INPUFF_T}{INPUFF_{1hr}}\right]\left(CTSCREEN_{1\ hr}\right) \qquad \text{Eq. 6.5-2}$$

where

DF_{CT}	=	complex terrain dispersion factor (or concentration) for exposure averaging time period "T" (μg/m^3)
$INPUFF_T$	=	INPUFF dispersion factor for exposure averaging time period "T" for a ground-level release with no cloud/plume rise (μg/m^3)
$INPUFF_{1\text{-}hr}$	=	INPUFF 1-hr dispersion factor for a ground-level release with no cloud/plume rise (μg/m^3)
$CTSCREEN_{1\text{-}hr}$	=	CTSCREEN 1-hr dispersion factor accounting for cloud/plume rise and actual terrain heights of source and receptor (μg/m^3)

The ISC2 model should be used to simulate OB/OD releases of greater than 1 hr per treatment event for simple terrain cases. ISCST2 should be used to evaluate exposure periods of 24-hr or less, while ISCST2 or ISCLT2 should be used for long-term exposures (e.g., quarterly and annual). For complex terrain cases the ISC2 models can be conservatively used if a ground-level cloud/plume is assumed. An alternative approach is to use the CTSCREEN model.

Dispersion modeling results should be obtained for each receptor location identified in Step 4.2.

Background emissions should also be modeled as warranted using a dispersion model that is appropriate for the source type. Military training and testing emissions are similar to OB/OD emissions as previously discussed. A conservative approach for evaluating these training/testing emissions is to use the same dispersion factor results obtained for OB/OD. (These OB/OD results can be scaled to account for the training/testing emissions.) An alternate approach would be to model the training/testing emissions as an area source using SCREEN2.

6.6 STEP 4.6: ADJUST DISPERSION FACTORS FOR EXPOSURE PERIODS

Maximum dispersion modeling results should be adjusted to provide maximum dispersion factors (concentrations associated with a 1-lb release) for all exposure periods commensurate with relevant health criteria (see Fig. 6.6-1). Typically, this involves the following standard exposure periods:

- 1-min
- 15-min
- 1-hr
- 3-hr
- 8-hr
- 10-hr
- 24-hr
- Quarterly
- Annual

Modeling results which present averaging periods consistent with the exposure periods of interest should be used directly. For example, dispersion factors for exposure periods of 1 hr or less can be obtained from the INPUFF output files.

Maximum dispersion factors for exposure periods of greater than 1 hr are based on adjusting the 1-hr dispersion factors as follows:

$$DF_T = \sum_{t=1}^{T} \left[\frac{DF_{1\text{-}hr_t}}{T} \right] (F) \qquad \text{Eq. 6.6-1}$$

where

DF_T = dispersion factor, or concentration, for exposure period of T hours for emission constituent of interest associated with a 1-lb/hr emission rate for a single OB/OD event ($\mu g/m^3$)

$DF_{1\text{-hr}_t}$ = 1-hr dispersion factor, or concentration, for the t^{th} hour for single OB/OD event, the release assumed to be 1 lb/hr for the first hour and 0.0 thereafter ($\mu g/m^3$)

T = number of hours in the exposure period of interest

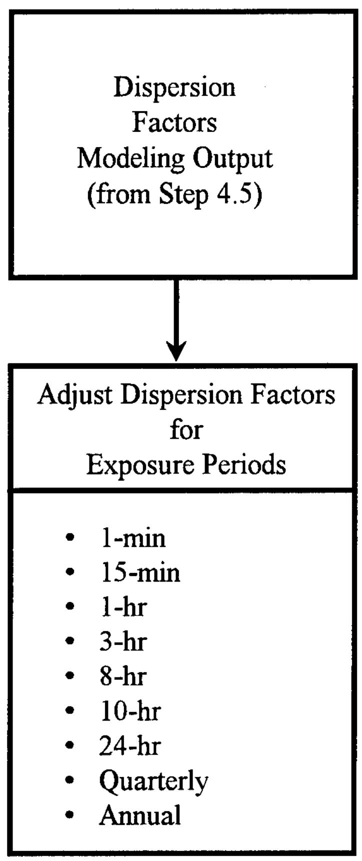


Fig. 6.6-1. Step 4.6: Adjust dispersion factors for exposure periods.

F = wind direction frequency in a fraction format (0.0-1.0), assumed to be 1.0 for exposures of 24-hr or less, maximum quarterly prevailing frequency for quarterly exposures, and annual prevailing frequency for annual exposure (fraction), dimensionless.

Eq. 6.6-1 is equivalent to Eq. 6.6-2 for a single OB/OD event (since DF values will all be zero except for the first hour).

$$DF_T = \frac{DF_{1-hr}}{N} (F) \qquad \text{Eq. 6.6-2}$$

where

$DF_{1\text{-hr}}$ = 1-hr concentration, or dispersion factor, for the first hour of a single OB/OD event, assuming a 1 lb/hr emission rate ($\mu g/m^3$)

An example of the application of Eq. 6.6-1 to adjust INPUFF modeling results is provided in Table 6.6-1. The procedure for accounting for the additive effects of multiple OB/OD events is based on the treatment quantity for the period of interest as explained in Section 6.7.

Table 6.6-1. Summary of maximum concentrations (dispersion factors) for various exposure periods — INPUFF[a]

Exposure period	Model	Calculation method
1-min	INPUFF	Model output[b]
15-min	INPUFF	Model output[c]
1-hr	INPUFF	Model output
3-hr	INPUFF	1-hr conc. ÷ 3
8-hr	INPUFF	1-hr conc. ÷ 8
10-hr	INPUFF	1-hr conc. ÷ 10
24-hr	INPUFF	1-hr conc. ÷ 24
Quarterly	INPUFF	1-hr conc. ÷ 24 ÷ 91.25 x F_q
Annual	INPUFF	1-hr conc. ÷ 24 ÷ 365 x F_a

F_q = maximum seasonal prevailing unit direction frequency as a fraction (0.0-1.0).

F_a = annual prevailing unit direction frequency as a fraction (0.0-1.0).

[a]Model results normalized to 1 lb per OB/OD event.
[b]Can be conservatively estimated by 1-hr concentration times 60 for SCREEN2, ISC2, and CTSCREEN.
[c]Can be conservatively estimated by 1-hr concentration times 4 for SCREEN2, ISC2, and CTSCREEN.

6.7 STEP 4.7: COMPUTE EXPOSURE CONCENTRATIONS

Dispersion factors (associated with one treatment event of 1-lb emission) for each exposure period should be used as input to calculate exposure concentrations for each potential emission contaminant for every receptor of interest as follows (also refer to Fig. 6.7-1):

$$EC_{TC} = (DF_T)\ (EF_C)\ (TQ_T) \qquad \text{Eq. 6.7-1}$$

where

EC_{TC} = concentration for exposure period T of contaminant C for receptor of interest ($\mu g/m^3$)

DF_T = dispersion factor (based on 1-lb emission) for exposure period T for receptor of interest ($\mu g/m^3$/lb)

EF_C = emission factor for contaminant C (based on Step 2) (lb/lb)

TQ_t = treatment quantity for period T (based on Step 1) (lb)

Exposure concentrations should be presented for the following data sets:

- OB
- OD
- OB/OD (i.e., combined impacts of OB plus OD for long-term exposures but not for short-term exposures unless there is a potential for significant additive effects)
- Background
- Background + OB/OD

These modeling estimates should be used to evaluate potential impacts on human health and the environment.

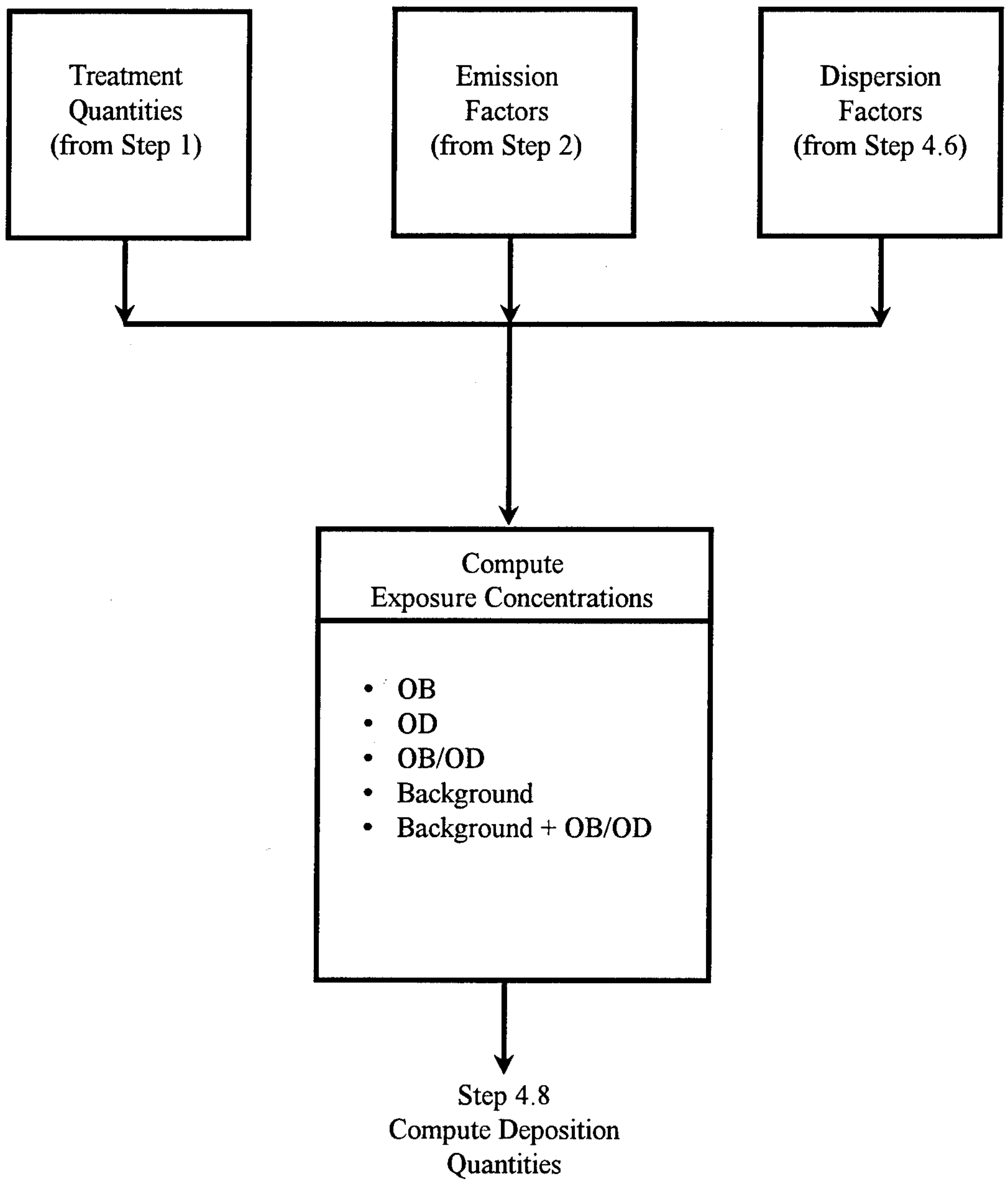


Fig. 6.7-1. Step 4.7: Compute exposure concentrations.

6.8 STEP 4.8: COMPUTE DEPOSITION QUANTITIES

Annual deposition quantities for OB/OD emissions can be estimated as follows for screening purposes (see Fig. 6.8-1):

$$DQ_{C\text{-}ANL} = (EC_{C\text{-}ANL})(DV)(3.15E7) \qquad \text{Eq. 6.8-1}$$

where

$DQ_{C\text{-}ANL}$ = annual deposition quantity for contaminant C at locations of interest (μg/m^2/yr)

$EC_{C\text{-}ANL}$ = annual exposure concentration of contaminant C at locations of interest (μg/m^3)

DV = typical deposition velocity for uncontrolled sources of 0.05 m/s (CAPCOA, 1993)

3.15E7 = number of seconds in one year (s/yr)

However, because of the large uncertainties involved with deposition modeling, site-specific soil sampling results are considered to provide a more realistic basis of accounting for potential deposition.

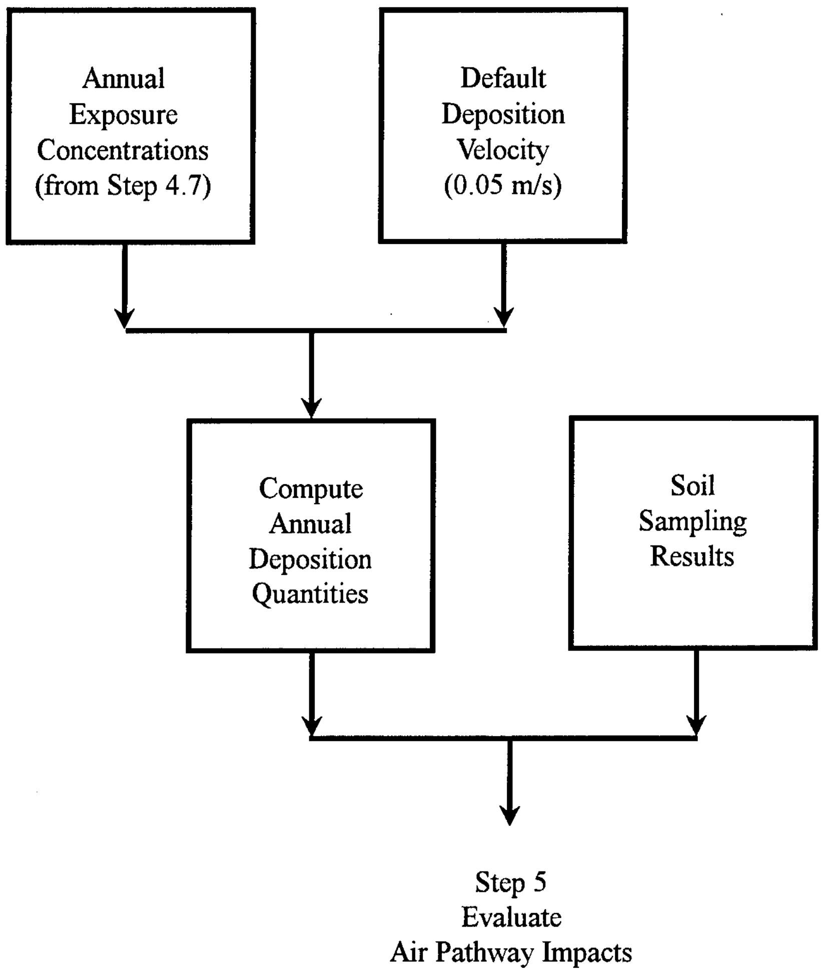


Fig. 6.8-1. Step 4.8: Compute deposition quantities.

7.0 STEP 5: EVALUATE AIR PATHWAY IMPACTS

Emission and dispersion modeling results should be used to estimate potential OB/OD impacts and to determine installation-specific allowable operating limits. The evaluation of air pathway impacts should involve the following steps (as illustrated in Fig. 7.0-1).

- Step 5.1: Calculate allowable OB/OD emission quantities
- Step 5.2: Calculate allowable OB/OD treatment quantities
- Step 5.3: Calculate Health Index values
- Step 5.4: Calculate maximum excess lifetime cancer risk
- Step 5.5: Evaluate potential environmental impacts due to air pathway exposures
- Step 5.6: Determine followup actions.

These steps are discussed in Sections 7.1 through 7.6 and provide the basis for the determination of installation-specific environmental performance standards.

Steps 5.1 (calculate allowable OB/OD emission quantities) and 5.2 (calculate allowable OB/OD treatment quantities) are optional. These steps, however, provide a basis for comparing installation-specific treatment needs versus allowable treatment amounts to select reasonable (i.e., achievable based on applicable health criteria) OB/OD treatment goals (limits) which can serve as environmental performance standards for Subpart X permitting purposes.

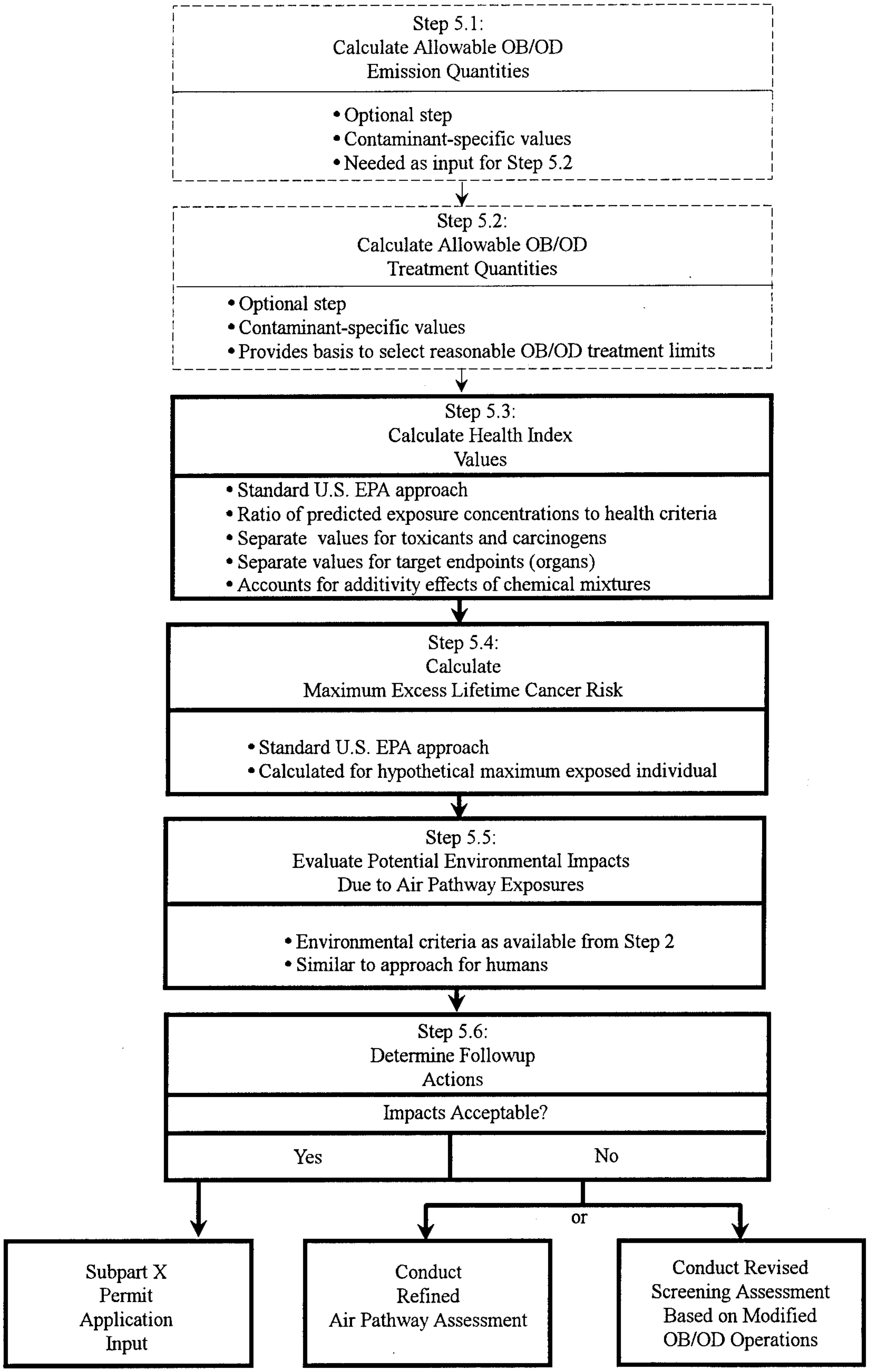


Fig. 7.0-1. Step 5: Evaluate air pathway impacts.

7.1 STEP 5.1: CALCULATE ALLOWABLE OB/OD EMISSION QUANTITIES

Allowable emission quantities for each potential contaminant should be calculated as follows for each exposure period of interest (i.e., exposure periods for relevant air criteria):

$$EQ_i = \frac{HC_i}{DF_T} \qquad \text{Eq. 7.1-1}$$

where

EQ_i = allowable emission quantity for contaminant of interest "i" (lb)

HC_i = most restrictive air pathway health criterion available for emission contaminant "i" and exposure period of interest as determined from Step 3 of the air pathway assessment screening protocol ($\mu g/m^3$)

DF_T = most restrictive dispersion factor, assuming a release of 1 lb for emission/exposure period of interest (T) as determined from Step 4 of the air pathway assessment screening protocol ($\mu g/m^3/lb$)

The calculated allowable emission quantity values should be summarized in a tabular format that depicts emission contaminant versus applicable health criteria exposure periods (from 1 min to annual). These values represent the most restrictive allowable OB/OD emission quantities for the list (as defined in Step 3) of candidate energetic material items for OB/OD treatment.

The allowable OB/OD emission quantities are used as input for Step 5.2.

7.2 STEP 5.2: CALCULATE ALLOWABLE OB/OD TREATMENT QUANTITIES

Allowable treatment quantities of energetic material items should be estimated for each potential emission contaminant and exposure period based on the following:

$$TQ_i = \frac{EQ_i}{EF_i} \qquad \text{Eq. 7.2-1}$$

where

TQ_i = allowable treatment quantity based on contaminant "i" health criteria limitations (lb)

EQ_i = allowable emission quantity as calculated in Step 5.1 based on contaminant "i" health criteria limitations (lb)

EF_i = most restrictive emission factor for contaminant "i" as calculated in Step 2 of the air pathway assessment screening protocol (lb of contaminant emission per lb of treatment item)

The calculated allowable treatment quantity values should be summarized in a tabular format depicting emission contaminant versus applicable health criteria exposure periods (from 1 min to annual).

The allowable treatment quantities based on contaminant-specific health criteria provide information to identify installation-specific limiting treatment quantities. For example, the minimum "allowable treatment quantity" for an exposure period considering the values for all potential emission contaminants represents the limiting treatment quantity. This limiting value should be compared to OB/OD treatment goals as identified in Step 1.1. If the treatment goal exceeds the limiting allowable treatment quantity, special (more restrictive) treatment limitations applicable only to those energetic material items associated with the highest emission factors for the limiting contaminant may be necessary.

7.3 STEP 5.3: CALCULATE HEALTH INDEX VALUES

The overall risk posed by one or more air emission constituents should be evaluated using containment-specific Health Quotient (HQ) values and a cumulative (i.e., sum of the HQ for all contaminants) Health Index (HI) that is generated for each health endpoint. For systemic toxicants with similar systemic effects, the HI takes the following form:

$$HI_{TOX} = \sum_{i=1}^{M} HQ_{TOX_i} \qquad \text{Eq. 7.3-1}$$

and

$$HQ_{TOX_i} = \frac{C_i}{HC_{TOX_i}} \qquad \text{Eq. 7.3-2}$$

where

HI_{TOX}	=	cumulative Health Index for toxicants for health endpoint of interest (dimensionless)
HQ_{TOX_i}	=	Health Quotient for the i^{th} toxicant (dimensionless)
C_i	=	concentration (exposure level) of the i^{th} toxicant ($\mu g/m^3$)
HC_{TOX_i}	=	health criterion for the i^{th} toxicant ($\mu g/m^3$)
M	=	total number of toxicants

The HI for carcinogens (HI_{CAN}) is similar:

$$HI_{CAN} = \sum_{i=1}^{N} HQ_{CAN_i} \qquad \text{Eq. 7.3-3}$$

and

$$HQ_{CAN_i} = \frac{C_i}{HC_{CAN_i}} \qquad \text{Eq. 7.3-4}$$

where

HI_{CAN}	=	cumulative Health Index for carcinogens for health endpoint of interest (dimensionless)
HQ_{CAN_i}	=	Health Quotient for the i^{th} carcinogen (dimensionless)
C_i	=	concentration (exposure level) of the i^{th} carcinogen ($\mu g/m^3$)

HC_{CAN_i}	=	health criterion concentration (exposure level) associated with an acceptable (reference) level of risk for the i^{th} carcinogen ($\mu g/m^3$), typically 10^{-6} for Class A/B carcinogens and 10^{-5} for Class C, based on RCRA RFI Guidance
N	=	total number of carcinogens

Health impacts may be unacceptable if any calculated HI exceeds unity (i.e., 1.0). HI values are computed for each standard exposure period based on the associated health criteria.

For data evaluation purposes it is recommended that contaminant-specific contributions to the cumulative HI scores be summarized in a tabular format for each standard exposure period (i.e., 1 min to annual). The total HI score is based on the combined impacts of OB and OD for all potential emission contaminants. The total HI values for toxicants and separate HI value for carcinogens should initially be calculated without regard to health impact endpoints (i.e., affected organs). This is a very conservative screening approach to characterizing potential health impacts, and the data should be so qualified in the Subpart X permit applications, if used. However, if these results yield an HI_{TOX} or HI_{CAN} score of 1.0 or greater, a more refined approach would be appropriate. This alternative approach would involve calculating separate HI values for each health impact endpoint. HI values of 1.0 or greater might also involve the need for more restrictive treatment goals (limits) for certain energetic material items (especially those with a high metal content) which are frequently a major factor for HI values that exceed 1.0.

The emission constituents regulated by the National Ambient Air Quality Standards (NAAQS) should not be included in the HI computations, since they are not enforced on an "additive basis" and these criteria were established considering the potential for synergistic effects.

7.4 STEP 5.4: CALCULATE MAXIMUM EXCESS LIFETIME CANCER RISK

The maximum excess lifetime cancer risk should be calculated in addition to the HI_{CAN} values for carcinogens. The maximum excess lifetime cancer risk is the probability that the hypothetical most exposed individual would contract cancer during a continuous exposure of 70 years. This risk value is typically used by regulatory agencies to compare potential impacts with "acceptable risk" estimates and to communicate these risks to the public. Following are two approaches which can be used to estimate maximum excess lifetime cancer risk:

$$CR = \sum_{i=1}^{N} \left[\frac{C_{ANL_i}}{HC_{CAN_i}} \right] (RR_i) \qquad \text{Eq. 7.4-1}$$

where

CR	=	maximum excess lifetime cancer risk
C_{ANL_i}	=	maximum predicted annual concentration for carcinogen "i" as defined in Step 5.3 ($\mu g/m^3$)
HC_{CAN_i}	=	health criterion associated with a reference excess lifetime risk for carcinogen "i" as defined in Step 5.3 ($\mu g/m^3$)
RR_i	=	reference excess lifetime risk for carcinogen "i" (as presented in standard references such as IRIS); a typical value for "RR" is 1×10^{-6} (dimensionless)
N	=	total number of carcinogens

An alternate approach to calculate excess lifetime cancer risk is based on the use of unit risk values (available from IRIS) as follows:

$$CR = \sum_{i=1}^{N} (C_{ANL_i}) \, (UR_i) \qquad \text{Eq. 7.4-2}$$

where

UR_i	=	unit risk value for the i^{th} carcinogen which represents the excess cancer risk associated with exposure to 1 $\mu g/m^3$ ($m^3/\mu g$)

7.5 STEP 5.5: EVALUATE POTENTIAL ENVIRONMENTAL IMPACTS DUE TO AIR PATHWAY EXPOSURES

Potential environmental impacts due to OB/OD air emissions should also be evaluated. Environmental criteria from Step 2 should be used as available. The same approach (i.e., Steps 5.1-5.4) should also be applied to the environmental assessment. Deposition and ingestion are of particular concern for environmental receptors. Thus, as for humans, a multi-media assessment is needed to evaluate total potential impacts.

7.6 STEP 5.6: DETERMINE FOLLOWUP ACTIONS

Potential followup actions after completion of the screening assessment for the air pathway are illustrated in Fig. 7.6-1. If the screening assessment indicates that the impacts are acceptable to human health and the environment, the results should be presented in the Subpart X permit application. If not, a refined assessment may be warranted based on more realistic assumptions, additional installation-specific data (e.g., onsite meteorological data), and the application of more sophisticated models. Another alternative is to conduct a revised screening assessment based on more restrictive environmental performance standards which involve modifications to the unit design, operation limitations, and/or less ambitious treatment goals.

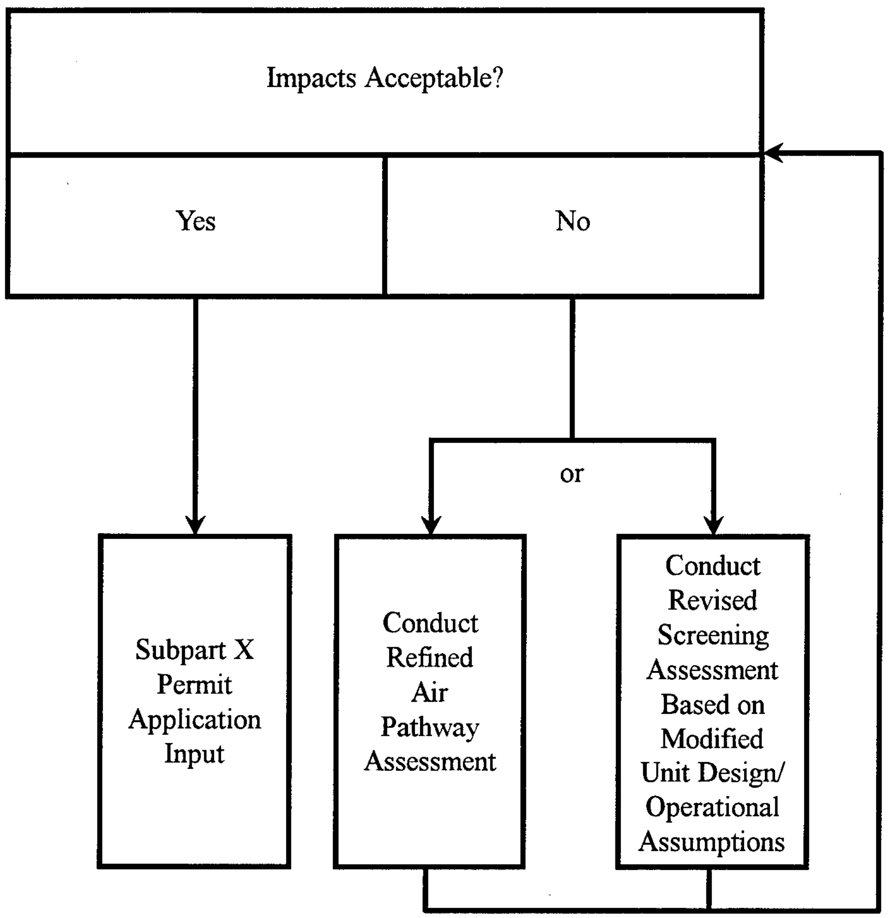


Fig. 7.6-1. Step 5.6: Determine followup actions.

8.0 REFERENCES

Baroody, E., April 1994. The POLU13L Program, Naval Surface Warfare Center, Indian Head, Md.

Baroody and Tominack, January 1987. Computer Predictions of Pollutant Products from Open Burn and Open Detonation of Navy Explosives and Pollutants, Naval Ordnance Station, Indian Head, Md.

CAPCOA (California Air Pollution Control Officers Association), 1993. Air Toxics "Hot Spots" Program Revised 1992 Risk Assessment Guidelines, Cameron Park, Calif.

Church, H., May 1969. Cloud Rise from High-Explosive Detonations, Sandia Laboratories, Albuquerque, N.M.

DNA (Defense Nuclear Agency), October 1981. High Explosives Field Tests - Explosive Phenomena and Environmental Impacts, AD/A135737.

Leakey et al., March 1993. "An Assessment of Air Quality Impacts of Fires Associated with Fire Fighting Operations," Air & Waste Management Journal, Vol. 43, Pittsburgh, Pa.

Lucas, J. and J. Bentley. "Development and Use of Critical Source Release Parameters for Air Dispersion Modeling of Open Burning and Open Detonation Treatment Units," Brown & Root Environmental. For presentation at the Air & Waste Management Conference, San Antonio, Tex.

Meyer, Rudolf, 1987. Explosives, Third Revised and Extended Edition, VCH Verlagsgesellschaft mbH, Weinheim, Germany.

NAVSEA SN060-AA-MMA-010 (formerly OP2212) 0640-LP-285-9800, September 1, 1989. Technical Manual Demolition Materials, First Revision.

ORNL, June 1994. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1994 Revision, Oak Ridge National Laboratory, Oak Ridge, Tenn.

ORNL, July 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1994 Revision, Oak Ridge National Laboratory, Oak Ridge, Tenn.

ORNL, September 1994a. Toxicological Benchmarks for Wildlife: 1994 Revision, Oak Ridge National Laboratory, Oak Ridge, Tenn.

ORNL, September 1994b. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision, Oak Ridge National Laboratory, Oak Ridge, Tenn.

ORNL, December 1994. Manual for PC-Data Base Screening Benchmarks for Ecological Risk Assessment, Oak Ridge National Laboratory, Oak Ridge, Tenn.

Schulze, R., January 1981. Notes on Dispersion Modeling, Trenitz Consultants, Dallas, Tex.

U.S. Air Force, January 1994. Characterization of Emissions Resulting from Thermal Treatment of Selected Explosive Munitions, prepared for the U.S. Air Force Air Combat Command by U.S. Army, Dugway Proving Ground, Utah.

U.S. Army, May 1975 and 1970, AMC Pamphlet 700-3-5. Logistics Complete Round Charts, Grenades, Mines, Pyrotechnics, Rockets, Rocket Motors, Demolition Material.

U.S. Army, November 1976. Development and Readiness Command, DARCOM Pamphlet 700-32, Complete Round Charts, Ammunition through 20mm.

U.S. Army, February 1977. Technical Manual 43-0001-36, Army Ammunition Data Sheets for Land Mines (FSC 1345).

U.S. Army, April 1977. Technical Manual 43-000-28, Army Ammunition Data Sheets, Artillery Ammunition Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers, and Artillery Fuzes.

U.S. Army, October 1977. Technical Manual 43-0001-29, Army Ammunition Data Sheets for Grenades.

U.S. Army, September 1984. Technical Manual 9-1300-214, Military Explosives.

U.S. Army, March 1986. Evaluation of Open Burning Traps, Ammunition Equipment Directorate, Tooele Army Depot, Tooele, Utah.

U.S. Army, October 1987. Combined Obscuration Model for Battlefield-Induced Contaminants, COMBIC, U.S. Army Laboratory Command, Atmospheric Sciences Laboratory, White Sands Missile Range, N.M.

U.S. Army, July 1988. Disposal of Supplies and Equipment - Authorizing, Accomplishing and Reporting Demilitarization of Class IV Materiel, AMC Regulation No. 755-8, U.S. Army Material Command, Alexandria, Va.

U.S. Army, June 1989. Development and Readiness Command, DARCOM Pamphlet 700-3-3, Logistics Complete Round Charts, Activity Ammunition and Fuzes.

U.S. Army, August 1989/May 1990. Environmental Hygiene Agency, Air Pollution Engineering Division, U.S. Army Propellant/Munitions Compositions (Draft).

U.S. Army, March 1990. Hazard Classification of United States Military Explosives and Munitions, Army Material Command, Savanna, Ill.

U.S. Army, February 1991. Department of the Army Field Manual 5-25, Explosives and Demolitions, HQ Department of the Army.

U.S. Army, January 1992. Development of Methodology and Technology for Identifying and Quantifying Emission Products from Open Burning and Open Detonation Thermal Treatment Methods, U.S. Army Armament, Munitions and Chemical Command Rock Island, Ill.

U.S. Army, June 1992. OD Dust Cloud Study.

USDA (U.S. Department of Agriculture), June 1960. Time - Temperature Relationships of Test Head Fires and Backfires, Research Notes - Southeastern Experiment Station No. 148.

U.S. EPA (U.S. Environmental Protection Agency), 1986a, 1987, 1993. Guidance on Air Quality Models.

U.S. EPA (U.S. Environmental Protection Agency), 1986b. A Multiple Source Gaussian Puff Dispersion Algorithm User's Guide.

U.S. EPA (U.S. Environmental Protection Agency), July 1987. User's Guide to Rough Terrain Diffusion Model (RTDM) (Rev. 3.20).

U.S. EPA (U.S. Environmental Protection Agency), September 1988. Control of Open Fugitive Dust Sources.

U.S. EPA (U.S. Environmental Protection Agency), December 1989. Risk Assessment Guidance for Superfund - Volume 1, Human Health Evaluation Manual (Part A), Interim Final. Office of Emergency and Remedial Response, Washington, D.C.

U.S. EPA (U.S. Environmental Protection Agency), 1990. User's Guide to CTDMPLUS: Volume 2. The Screening Mode (CTSCREEN).

U.S. EPA (U.S. Environmental Protection Agency), August 1990. TSCREEN: A Model for Screening Toxic Air Pollutant Concentrations.

U.S. EPA (U.S. Environmental Protection Agency), January 1991. User's Guide for the Fugitive Dust Model (FDM) (Revised), Seattle, Wash.

U.S. EPA (U.S. Environmental Protection Agency), March 1992. User's Guide for the Industrial Source Complex (ISC2) Dispersion Models, Volume I - User Instructions.

U.S. EPA (U.S. Environmental Protection Agency), October 1992. Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised.

U.S. Navy, 1989. Computer Predictions of Pollution Products from Open Running and Open Detonation of Explosives and Propellants, Final Report, Indian Head, Md., August 4.

APPENDICES

APPENDIX A

SECTION 1.0 SUPPORT MATERIAL

APPENDIX A

RESERVED FOR POTENTIAL FUTURE USE

APPENDIX B

SECTION 2.0 SUPPORT MATERIAL

APPENDIX B

RESERVED FOR POTENTIAL FUTURE USE

APPENDIX C

SECTION 3.0 SUPPORT MATERIAL

- **C-1 Master List of All the Energetic Material Items That Have DODAC Numbers and Identification of Items That Have Been Characterized**
- **C-2 Army-Wide Energetic Material Items Chemical Composition Data Base**
- **C-3 Average and Range of Weight Composition by Constituent (Summarized by Family)**
- **C-4 Average and Range of Weight Composition by Constituent (OB and OD)**
- **C-5 Characterization of Typical Casings**

APPENDIX C-1

MASTER LIST OF ALL THE ENERGETIC MATERIAL ITEMS THAT HAVE DODAC NUMBERS AND IDENTIFICATION OF ITEMS THAT HAVE BEEN CHARACTERIZED

The database on this disk is an Microsoft Access 2.0 RDBMS. You must have Microsoft Access 2.0 to access this database.

This database contains the data and reports that were generated for this document. The data is in the table NEWMAST.

There are 10 reports generated for this document. They are:

- ITEM_SUMMARY_BY_CLASS
- ITEM_SUMMARY_WITH_CHEMICALS
- OB-SUMMARY
- OB1-SUMMARY
- OD-SUMMARY
- SUMMARY_BY_CLASS
- SUMMARY_CLASS_12A_12B
- SUMMARY_CLASS_1A_1B_1C
- SUMMARY_CLASS_1B_1C
- SUMMARY_CLASS_4A_4B

Here is a brief description of what each report contains:

ITEM_SUMMARY_BY_CLASS is a report which lists DODAC number, type of round, class, and item grouped by class.

ITEM_SUMMARY_WITH_CHEMICALS is a report which lists the DODAC number, item, constituent, constituent weight, and constituent weight percentage. The report is grouped by the item and sorted by the DODAC number.

OB-SUMMARY is a report which lists constituent, constituent's maximum weight (maximum weight for the specific class by constituent), and the constituent's average weight (averaged over the specific class for each constituent) for Open Burning. The report is sorted by constituent.

OB1-SUMMARY is a report which lists constituent, constituent's maximum weight (maximum weight for the specific class by constituent), and the constituent's average weight (averaged over the specific class for each constituent) for Open Burning[1]. The report is sorted by constituent.

OD-SUMMARY is a report which lists constituent, constituent's maximum weight (maximum weight for the specific class by constituent), and the constituent's average weight (averaged over the specific class for each constituent) for Open Detonation. The report is sorted by constituent.

SUMMARY_BY_CLASS is a report which lists constituent, constituent's maximum weight (maximum weight for the specific class by constituent), and the constituent's average weight (averaged over the specific class for each constituent) grouped by class. The report is sorted by constituent.

SUMMARY_CLASS_12A_12B is a report which lists constituent, constituent's maximum weight (maximum weight for the specific class by constituent), and the constituent's average weight (averaged over the specific class for each constituent) for classes 12a and 12b. The report is sorted by constituent.

SUMMARY_CLASS_1A_1B_1C is a report which lists constituent, constituent's maximum weight (maximum weight for the specific class by constituent), and the constituent's average weight (averaged over the specific class for each constituent) for classes 1a, 1b, and 1c. The report is sorted by constituent

SUMMARY_CLASS_1B_1C is a report which lists constituent, constituent's maximum weight (maximum weight for the specific class by constituent), and the constituent's average weight (averaged over the specific class for each constituent) for classes 1b and 1c. The report is sorted by constituent.

SUMMARY_CLASS_4A_4B is a report which lists constituent, constituent's maximum weight (maximum weight for the specific class by constituent), and the constituent's average weight (averaged over the specific class for each constituent) for classes 4a and 4b. The report is sorted by constituent.

To generate these reports select the report you want and click on the preview button. When the report appears on the screen click on the printer icon. If you do not have a HP LaserJet III or above the report may not be formatted properly.

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1305-A066	CTG	1a	5.56MM BALL M193 CTN PACK
1305-A068	CTG	1a	5.56MM TR M195 CTN PACK
1305-A071	CTG	1a	5.56MM BALL M193 10/CLIP
1305-A075	CTG	1a	5.56MM BLANK M200 LNKD
1305-A080	CTG	1a	5.56MM BLANK M200 SNGL RD
1305-A090	CTG	1a	CAL .22 TR PRAC M861
1305-A111	CTG	1a	7.62MM BLANK M82 LNKD
1305-A112	CTG	1a	7.62MM BLANK M82 CTN PACK
1305-A122	CTG	1a	7.62MM BALL M59/M80 CTN PACK
1305-A124	CTG	1a	7.62MM TR M62 CTN PACK
1305-A140	CTG	1a	7.62MM TR M62 CTN PACK
1305-A400	CTG	1a	CAL .38 SPEC BALL M41 130 GRAIN
1305-A404	CTG	1a	CAL .38 SPEC WADCUTTER
1305-A475	CTG	1a	CAL .45 BALL M1911
1305-A555	CTG	1a	CAL .50 BALL M2/M33 LNKD
1305-A572	CTG	1a	CAL .50 TR M17 LNKD
1305-A585	CTG	1a	CAL .50 API-T M20 LNKD
1330-G839	CTG	1a	GREN RIFLE 7.62MM M64
1325-F680	FUZE	1b	BOMB NOSE M904E2
1325-F835	FUZE	1b	BOMB NOSE M904 E2/E3
1325-F989	FUZE	1b	BOMB TAIL M905
1330-G870	FUZE	1b	HAND GREN PRAC M205
1330-G872	FUZE	1b	HAND GREN OFF M206/M6

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1330-G873	FUZE	1b	HAND GREN FRAG M204 SERIES
1330-G874	FUZE	1b	HAND GREN M201A1
1330-G877	FUZE	1b	HAND GREN M213
1330-G878	FUZE	1b	HAND GREN PRAC M228
1345-K051	FUZE	1b	M604 F/AT PRAC MINE M10A1, M12, M20
1345-K058	FUZE	1b	M605 COMB F/M16 SERIES MINE
1365-K887	FUZE	1b	SMOKE POT M207A1 MECH
1375-M670	FUSE	1b	BLASTING TIME M700
1390-N248	FUZE	1b	MT M565 W/O BOOSTER
1390-N334	FUZE	1b	PD M567 DELAY W/O BOOSTER
1390-N335	FUZE	1b	PD M557 DELAY W/BOOSTER NON-PROP PKG
1390-N340	FUZE	1b	PD M739 00-574-7705
1390-N402	FUZE	1b	PROX M532 WRBND BX
1310-B617	CTG	1c	IGN M702 SERIES F/60MM MORTAR
1315-C242	CTG	1c	IGN M6 F/81MM MORTAR
1315-C713	CTG	1c	IGNITION M2 F/4.2 MORTAR
1315-C751	BSTR	1c	PROJ M53/M53A1 F/105MM WP CTG
1320-D151	BURSTER	1c	PROJ M71 F/GAS PROJ 155MM
1320-D152	BURSTER	1c	PROJ XM54 BURSTER
1320-D153	BURSTER	1c	PROJ M83
1320-D512	BURSTER	1c	XM54 PROJECTILE BURSTER
1345-K002	ACTVR	1c	M1 F/AT MINE PRAC M12A1
1346-K001	ACTVR	1c	AT MINE M2

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1370-L130	PRIMER	1c	PERC F/DISCHARGER SMK PUFF
1370-L594	SIM	1c	PROJ GRND BURST M115A1
1375-M120	CAP	1c	BLASTING ELEC NO 8
1375-M121	CAP	1c	BLASTING ELEC NO 8
1375-M130	CAP	1c	BLASTING ELEC M6
1375-M131	CAP	1c	BLASTING NON-ELEC M7
1375-M327	CPLGBASE	1c	FIRING DEVICE W/PRIMER
1375-M448	DET	1c	PERC M2A1 8 SEC DELAY
1375-M450	DET	1c	PERC M1A2
1375-M616	FD	1c	DEMO M1 6-14 MIN DELAY
1375-M626	FD	1c	DEMO PRESSURE M1
1375-M627	FD	1c	DEMO PRESSURE RELEASE M
1375-M629	FD	1c	DEMO PULL RELEASE M3
1375-M630	FD	1c	DEMO PULL M1
1375-M766	IGNITER	1c	M2/M60 F/TIME BLASTING FUSE
1375-M810	PRIMER	1c	PERC M2/M3
1375-M965	CHG	1c	DEMO CRATERING M180
1375-ML03	FD	1c	DEMO MULTI-PURPOSE M142
1377-M500	CUTTER	1c	CTG ACT M21 F/REEFING LINE
1377-M842	SQUIB	1c	ELEC M1
1377-M851	SQUIB	1c	ELEC M1A1
1390-N518	PRIMER	1c	PERC M28
1390-N519	PRIMER	1c	PERC M57

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1390-N523	PRIMER	1c	PERC M82
1390-N525	PRIMER	1c	PERC MK2A4
1390-N538	PRIMER	1c	ELEC MK49 MOD 4
1310-B475	CTG	2	40MM YLW SMK CANOPY M676
1310-B506	CTG	2	40MM RED SMK M713
1310-B508	CTG	2	40MM GRN SMK M715
1310-B509	CTG	2	40MM YLW SMK M716
1310-B538	CTG	2	40MM RED SMK M675
1310-B590	CTG	2	57MM SMK WP M308A1
1310-B630	CTG	2	60MM SMK WP M302 SERIES
1315-C032	CTG	2	75MM SMK WP M64
1315-C056	CTG	2	75MM SMK WP M311
1315-C128	CTG	2	76MM SMK WP M361
1315-C230	CTG	2	81MM SMK WP M57/57A1 W/PD FUZE
1315-C451	CTG	2	105 MM SMK GRN M84 SERIES
1315-C452	CTG	2	105 MM SMK HC M84 SERIES
1315-C454	CHG	2	105 MM SMK WP M60 SERIES
1315-C477	CHG	2	105 MM SMK WP M60 SERIES W/O FUZE
1315-C512	CTG	2	105 MM SMK WP-T M416 W/BD FUZE
1315-C708	CTG	2	4.2 IN SMK WP M2/M328 SERIES W/PD FUZE
1315-C806	PJ&PPCHG	2	120MM SMK WP-T T16E3
1320-D445	CAN	2	SMK HC M1 F/155MM M116 SERIES
1320-D446	CAN	2	SMK GRN M3 F/155MM M116

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1320-D447	CAN	2	SMK RED M3 F/155MM M116
1320-D448	CAN	2	SMK VI0 M3 F/155MM M116
1320-D449	CAN	2	SMK YLW M3 F/155MM M116
1320-D451	CAN	2	SMK GRN M4 F/155MM M116
1320-D452	CAN	2	SMK RED M4 F/155MM M116
1320-D453	CAN	2	SMK VI0 M4 F/155MM M116
1320-D454	CAN	2	SMK YLW M4 F/155MM M116
1320-D550	PROJ	2	155MM SMK WP M105/M110 SERIES
1325-F562	CTG	2	SIGNAL MK4 MOD 0/1/3
1330-G815	GRENADE	2	SMK SCREENING RP UK L8A3 01-124-5031
1330-G930	GRENADE	2	HAND SMK HC AN-M8
1330-G935	GRENADE	2	HAND SMK WP M15
1330-G940	GRENADE	2	HAND SMK GRN M18
1330-G945	GRENADE	2	HAND SMK YLW M18
1330-G950	GRENADE	2	HAND SMK RED M18
1330-G955	GRENADE	2	HAND SMK VIO M18
1345-K040	CHG	2	SPOTTING F/MINE AP PRAC M8
1365-K865	SMK POT	2	M1 HC (5-8 MIN BURN)
1310-B535	CTG	3	40MM ILLUM WHT STAR PARA M583
1310-B536	CTG	3	40MM ILLUM WHT STAR CLSTR M585
1310-B627	CTG	3	60MM ILLUM M83A3
1315-C449	CTG	3	105 MM ILLUM M314 SERIES
1315-C706	CTG	3	4.2 IN ILLUM M335 SERIES

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1320-D505	PROJ	3	155MM ILLUM M485 SERIES
1370-L495	FLARE	3	SURF TRIP PARA YLW M49 SERIES
1370-L596	SIM	3	FLASH ARTY M110
1375-M610	DSTR	3	FILE INCD M4
1375-M611	DSTR	3	FILE INCD M4
1305-A365	CTG	4a	14.5MM TRAINER M181 3 SEC DELAY
1305-A652	CTG	4a	20MM TP-T M220 SERIES LNKD
1305-A655	CTG	4a	20MM 7 HEI M56 SERIES/1 TP-T M220 LNKD
1305-A659	CTG	4a	20MM HEI-T M242A1 SNGL RD
1305-A662	CTG	4a	20MM HEI M56 SERIES LNKD
1305-A701	CTG	4a	20MM HEI M56A3 SERIES LNKD
1305-A775	CTG	4a	20MM HEI M97 SNGL RD
1305-A776	CTG	4a	20MM INC M96 SNGL RD
1305-A785	CTG	4a	20MM HEI M210 SNGL RD
1305-A792	CTG	4a	20MM HEI-T-SD M246 SERIES LNKD RHF
1305-A806	CTG	4a	20MM API MK107 MODS SNGL RD
1305-A809	CTG	4a	20MM HPT T131 SNGL RD
1305-A811	CTG	4a	20MM TP MK105 SNGL RD
1305-A812	CTG	4a	20MM AP-T MK108 SNGL RD
1305-A872	CTG	4a	20MM API MK107 MOD 1 SNGL RD
1305-A873	CTG	4a	20MM AP-T MK108 MOD 1 SNGL RD
1305-A874	CTG	4a	20MM TP MK105 MOD 1 SNGL RD
1305-A876	CTG	4a	20MM TP MK105 MOD 0 SNGL RD

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1305-A884	CTG	4a	20MM API M53 LNKD
1305-A890	CTG	4a	20MM HEI M56 SERIES SNGL RD
1305-A892	CTG	4a	20MM HPT M54A1 SNGL RD
1305-A974	CTG	4a	25MM APDS-T M791 LNKD
1305-A975	CTG	4a	25MM HEI-T M792 LNKD
1305-A976	CTG	4a	25MM TP-T M793 LNKD
1305-A978	CTG	4a	25MM TP PGU-23/U SNGL RD
1305-B112	CTG	4a	30MM HEI MK3Z LNKD LHF
1305-B113	CTG	4a	30MM TP MK4Z LNKD LHF
1305-B114	CTG	4a	30MM HEI M3Z-1 LNKD RHF
1305-B115	CTG	4a	30MM TP MK4Z LNKD RHF
1305-B119	CTG	4a	30MM TP M788 LNKD LHF
1305-B120	CTG	4a	30MM TP M788 LNKD RHF
1305-B124	CTG	4a	30MM HEI M799 LNKD LHF
1305-B125	CTG	4a	30MM HEI M799 LNKD RHF
1310-B470	CTG	4a	40MM HE M384 SERIES LNKD
1310-B480	CTG	4a	40MM TP M385 SERIES LNKD F/HELI LAUNCHER
1310-B519	CTG	4a	40MM TP M781
1310-B534	CTG	4a	40MM MP M576
1310-B542	CTG	4a	40MM HEDP M430 LNKD
1310-B545	CTG	4a	40MM BLANK SALUTING
1310-B546	CTG	4a	40MM HEDP M433 (PA120 MTL CNTR)
1310-B551	CTG	4a	40MM AP M81A1 CLIPPED

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1310-B553	CTG	4a	40MM HEP MK2
1310-B555	CTG	4a	40MM HEI-P MK2
1310-B556	CTG	4a	40MM HEI-P-NP
1310-B557	CTG	4a	40MM HEI-SD 4/CLIP
1310-B558	CTG	4a	40MM HEI-T-NSD 4/CLIP
1310-B559	CTG	4a	40MM HEI-T-SD 4/CLIP
1310-B560	CTG	4a	40MM HEI-T-DI-SD
1310-B561	CTG	4a	40MM HE-P
1310-B562	CTG	4a	40MM HE-T-SD MK2
1310-B563	CTG	4a	40MM BL-P
1310-B564	CTG	4a	40MM BL-T 4/CLIP
1310-B568	CTG	4a	40MM HE M406
1310-B569	CTG	4a	40MM HE M406
1310-B571	CTG	4a	40MM HE M383E1 LNKD
1310-B572	CTG	4a	40MM HE M384 SERIES LNKD
1310-B573	CTG	4a	40MM HE M684 LNKD
1310-B576	CTG	4a	40MM TP M385 LNKD
1310-B586	CTG	4b	57MM HE M306A1
1310-B587	CTG	4b	57MM HEAT M307 SERIES
1310-B588	CTG	4b	57MM TP M306A1
1310-B632	CTG	4b	60MM HE M49 SERIES
1310-B642	CTG	4b	60MM HE XM720
1310-B643	CTG	4b	60MM HE M888

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1310-B666	CTG	4b	3 POUNDER BLNK MK1-1
1310-C546	CTG	4b	60-MM HIGH EXPLOSIVE CARTRIDGE XM720
1315-C025	CTG	4b	75MM BLANK M337A2
1315-C027	CTG	4b	75MM HE M48
1315-C051	CTG	4b	75MM HE M309 SERIES
1315-C052	CTG	4b	75MM HEAT M310
1315-C053	CTG	4b	75MM HEP-T M349
1315-C057	CTG	4b	75MM HE M309A1
1315-C098	CTG	4b	76MM TP-T M340A1
1315-C112	CTG	4b	76MM HE IR MX165
1315-C113	CTG	4b	76MM HE PD MX166
1315-C120	CTG	4b	76MM AP-T M339
1315-C122	CTG	4b	76MM HE M352
1315-C222	CTG	4b	81MM HE M362 SERIES W/PD FUZE
1315-C223	CTG	4b	81MM HE M362 W/O FUZE
1315-C225	CTG	4b	81MM HE M43A1 W/PD FUZE M525
1315-C227	CTG	4b	81MM TP M43A1 W/PD FUZE
1315-C236	CTG	4b	81MM HE M374 SERIES W/O PD FUZE
1315-C256	CTG	4b	81MM HE M374 SERIES W/PD FUZE
1315-C262	CTG	4b	90MM CANISTER APER M336
1315-C265	CTG	4b	90MM HE M71 W/MTSQ FUZE M502
1315-C266	CTG	4b	90MM HE M71 W/PD FUZE
1315-C267	CTG	4b	90MM HE M71 W/O FUZE

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1315-C275	CTG	4b	90MM APER-T M580 SERIES
1315-C276	CTG	4b	81MM SMK WP M375A3 W/PD FUZE 00-574-7680
1315-C280	CART	4b	90MM, M71A1 2/P
1315-C282	CTG	4b	90MM HEAT M371A1
1315-C283	CTG	4b	90MM PRAC M371
1315-C285	CTG	4b	90MM AP-T M318 SERIES
1315-C287	CTG	4b	90MM HE-T M71A1
1315-C290	CTG	4b	90MM TP-T M353
1315-C429	CTG	4b	105MM HEP-T M393 SERIES
1315-C430	CTG	4b	105MM HE M1 W/O FUZE
1315-C432	CTG	4b	105MM HE M1 W/PD FUZE M557
1315-C440	CTG	4b	105 MM BLANK M395
1315-C444	CHG	4b	105 MM HE M1 W/PD FUZE
1315-C445	CTG	4b	105 MM HE M1 W/O FUZE
1315-C462	CTG	4b	105 MM HE M444
1315-C494	CTG	4b	105 MM APDS-T M728
1315-C503	CTG	4b	105 MM TP-T M393A1
1315-C505	CTG	4b	105 MM APDS-T M392A2
1315-C506	CTG	4b	105 MM APDS-T M392/L36A1
1315-C508	CTG	4b	105 MM HEAT-T M456 SERIES
1315-C510	CTG	4b	105 MM TP-T M467
1315-C511	CTG	4b	105 MM TP-T M490/M456E1
1315-C513	CTG	4b	105 MM APERS-T M546

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1320-D544	PROJ	4b	155MM HE M107 (TNT) 00-529-7331
1320-D563	PROJ	4b	155MM HE APER M483 SERIES
1320-D569	PROJ	4b	155MM HE M101
1320-D570	CTG	4b	165MM HEP M123A1 (COMP A-3)
1320-D572	PROJ	4b	175MM HE M437A1/437A2 (TNT)
1320-D579	PROJ	4b	155MM HE RAP M549 SERIES (COMP B)
1320-D591	PROJ	4b	175MM HE M437A2 (COMP B)
1320-D592	CTG	4b	152MM HE M657E2
1315-C995	LCR&CTG	5	84MM M136 AT-4
1337-V172	RCKT MTR	5	XM22E8 (HAWK)
1340-H342	RCKT MTR	5	JATO MK25 MOD 1
1340-H343	RCKT MTR	5	JATO MK7 MOD 2 W/O IGNITER
1340-H345	RCKT MTR	5	JATO MK7 MOD 1 W/O IGNITER
1340-H555	RCKT	5	66MM HEAT M72
1340-H708	RCKT	5	35MM PRAC SUB-CAL M73
1340-J106	RCKT MTR	5	2.75 IN MK125 SERIES
1340-J263	IGNITER	5	RCKT MTR M20A1
1410-PB18	GM	5	SURF ATTACK PRAC BTM-71-A STD RANGE (TOW)
3427-PL22	GM	5	W/LNCHR SURF ATTACK PRAC M223 (DRAGON)
3427-PL23	GM	5	W/LNCHR SURF ATTACK M222 (DRAGON)
1315-F382	BOMB	6	ADAPTER BOOSTER BOMB MOD TA6E4
1325-E463	BOMB	6	GP 250 LB MK81 MOD 1 H-6/TRITONAL
1325-E464	BOMB	6	GP 250 LB MK81 MOD 0 TRITONAL

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1315-C518	CTG	4b	105 MM HEP-T M393A2
1315-C519	CTG	4b	105MM APERS-T M494 SERIES
1315-C521	CTG	4b	105 MM APFSDS-T CARTRIDGE M735
1315-C521	CTG	4b	105MM APFSDS-T M735
1315-C523	CTG	4b	105MM APFSDS-T M774
1315-C650	CTG	4b	106MM HEAT M344A1 W/PIBD FUZE
1315-C651	CTG	4b	106MM HEP-T M346 SERIES
1315-C660	CTG	4b	106MM APERS-T M581
1315-C697	CTG	4b	4.2 IN HE M329A2 W/O FUZE
1315-C699	CTG	4b	4.2 IN HE M329A2 W/O FUZE
1315-C703	CTG	4b	4.2 IN H/HD M2 SERIES
1315-C704	CTG	4b	4.2 IN HE M329 SERIES W/PD FUZE
1315-C705	CTG	4b	4.2 IN HE M329 SERIES W/O FUZE
1315-C800	PJ&PJCHG	4b	120MM HE T15E3
1315-C801	PJ&PRCHG	4b	120MM HE M356
1315-C804	PJ&PPCHG	4b	120MM TP-T M359
1315-C807	PJ&PPCHG	4b	120MM HEAT-T M469
1320-D381	CTG	4b	152MM HEAT-T M409 SERIES
1320-D383	CTG	4b	152MM TP-T M411 SERIES
1320-D485	PROJ	4b	155MM HE M101
1320-D503	PROJ	4b	155MM HE RAAM-L M718
1320-D509	PROJ	4b	155MM HE RAAM-S M741
1320-D510	PROJ	4b	155MM HEAT M712 (COPPERHEAD)

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1325-E465	BOMB	6	GP 250 LB MK81 MOD 1 H-6/TRITONAL
1325-E480	BOMB	6	GP 500 LB MK82 MOD 1
1325-E485	BOMB	6	GP 500 LB MK82 MOD 1 TRITONAL
1325-E506	BOMB	6	GP 1000 LB MK83 MOD 4
1325-E807	DSP&BOMB	6	ACFT LS FAE CBU 55/B
1325-E820	DSP&BOMB	6	ACFT CBU 59/B
1325-F372	ADAPTER	6	BOOSTER T45E7
1325-F382	ADAPTER	6	BOOSTER BOMB T46E3/E3
1310-B537	CTG	7	40MM CHEM AGENT CS M674
1315-C710	CTG	7	4.2 IN CS M630 W/MTSQ FUZE
1330-G960	GRENADE	7	HAND RIOT CN M7 SERIES
1330-G963	GRENADE	7	HAND RIOT CS M7 SERIES
1365-K515	CHEMAGT	7	CN
1365-K531	DSP&RCA	7	XM32
1365-K765	RCA	7	CS
1365-K768	RCA	7	CS-1
1375-M023	CHG	8	DEMO BLOCK M112 1 1/4 LB COMP C-4
1375-M024	CHG	8	DEMO BLOCK M118 2 LB PETN
1375-M026	DEMO KIT	8	BANGALORE TORP M1A1
1375-M028	DEMO KIT	8	BANGALORE TORP M1A2
1375-M030	CHG	8	DEMO BLOCK TNT 1/4 LB
1375-M031	CHG	8	DEMO BLOCK TNT 1/2 LB
1375-M032	CHG	8	DEMO BLOCK TNT 1 LB

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1375-M034	CHG	8	DEMO BLOCK TNT 8 LB
1375-M035	CHG	8	DEMO CHAIN M1 8 X 2 1/2 LB
1375-M039	CHG	8	DEMO BLOCK 40 LB CRATERING
1375-M060	CHG	8	DEMO ROLL M186 25 LB COMP H-6
1375-M420	CHG	8	DEMO SHAPED M2 SERIES 15 LB
1375-M421	CHG	8	DEMO SHAPED M3 SERIES 40 LB
1375-M445	DEMO KIT	8	PROJ CHG AP M1/M1A1
1375-M455	CORD	8	DET PETN
1375-M456	CORD	8	DET PETN TYP 1 CL E (NEW-1000 FT)
1375-M540	DET KIT	8	CONCUSSION M1
1375-M591	DYNA	8	DYNAMITE MILITARY M1
1375-M756	CHG	8	DEMO CHAIN M37 SERIES
1375-M757	CHG	8	ASSY DEMO M183 COMP C-4 8 X 2 1/2 LB
1375-M965	CHG	8	CHG DEMO CRATERING M180
1375-ML15	CHG	8	DEMO FLEX LINEAR SHAPED 225 GR/FT
1375-ML16	CHG	8	DEMO FLEX LINEAR SHAPED 300 GR/FT
1375-ML17	CHG	8	DEMO FLEX LINEAR SHAPED 400 GR/FT
1375-ML18	CHG	8	DEMO FLEX LINEAR SHAPED 500 GR/FT
1375-ML19	CHG	8	DEMO FLEX LINEAR SHAPED 600 GR/FT
1375-MW84	CHG KIT	8	DEMO TUBULAR MK75
1330-G880	GRENADE	9	HAND FRAG M61
1330-G881	GRENADE	9	HAND FRAG M67
1330-G888	GRENADE	9	GRENADE HAND FRAG M67

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1330-G890	GRENADE	9	HAND FRAG MK2/M26 SERIES
1330-G892	GRENADE	9	HAND FRAG MK2A1
1330-G911	GRENADE	9	HAND OFF MK3A2
1330-G970	GRENADE	9	RIFLE HEAT M28/M31
1345-K090	MINE	9	AP M2 SERIES
1345-K092	MINE	9	APER M16 SERIES BOUNDING
1345-K120	MINE	9	AP M3
1345-K121	MINE	9	APERS M14
1345-K143	MINE	9	APERS M18A1 W/M57 FIRING DEVICE
1345-K145	MINE	9	APERS M18A1 W/O FIRING DEVICE
1345-K146	MINE	9	APERS M26 BOUNDING
1345-K180	MINE	9	AT HEAVY M15
1345-K181	MINE	9	AT HEAVY M21
1345-K250	MINE	9	AT HEAVY M19 NON-METALLIC
1315-C136	CTG	10	3 IN 50 CAL VT MK33
1315-C137	CTG	10	3 IN 50 CAL VT MK33
1315-C143	CTG	10	3 IN 50 CAL AP MK29
1315-C150	CTG	10	3 IN 50 CAL VT NSD MK33
1315-C152	CTG	10	3 IN 50 CAL VT SD MK33
1315-C162	CTG	10	3 IN 50 CAL VT NON-FRAG MK33
1315-C164	CTG	10	3 IN 50 CAL VT NON-FRAG MK33
1315-C172	CTG	10	3 IN 50 CAL ILLUM MK25 MODS
1315-C178	CTG	10	3 IN 50 CAL BL-T MK27

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1315-C179	CTG	10	3 IN 50 CAL BL-P MK27
1315-C183	CTG	10	3 IN 50 CAL BLANK
1315-C212	CTG	10	3 IN 50 CAL AP MK29
1315-C215	CTG	10	3 IN 50 CAL AP MK29
1315-C218	CTG	10	3 IN 50 CAL HC MK27
1315-C296	CTG	10	3 IN 50 CAL HC MK27
1315-C299	CTG	10	3 IN 50 CAL AA MK27 NON-FL
1315-C302	CTG	10	3 IN 50 CAL AA MK27 FLASHLESS
1315-C305	CTG	10	3 IN 50 CAL ILLUM MK25
1315-C306	CTG	10	3 IN 50 CAL HE-IR MK33
1315-C307	CTG	10	3 IN 50 CAL HE-IR MK33
1315-C319	CTG	10	3 IN 50 CAL VT NON-FRAG MK31
1315-C320	CTG	10	3 IN 50 CAL VT NON-FRAG MK31
1315-C321	CTG	10	3 IN 50 CAL HE-IR MK31 NON-FL
1315-C322	CTG	10	3 IN 50 CAL HE-IR MK31 FLASHLESS
1315-C338	CTG	10	3 IN 50 CAL BL-P MK29/27/189
1315-C341	CTG	10	3 IN 50 CAL BL-P MK29/27/185 FLASHLESS
1315-C347	CTG	10	3 IN 50 CAL HC MK33 FLASHLESS
1315-C348	CTG	10	3 IN 50 CAL HC MK33 NON-FL
1315-C373	CTG	10	3 IN 50 CAL VT NON-FRAG MK36 NFL
1315-C375	CTG	10	3 IN 50 CAL VT NON-FRAG MK36 NFL
1320-D651	PROJ	10	8 IN HE DPICM M509/509E1
1320-D680	PROJ	10	8 IN HE M106

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
1320-D543	PROJ	11	155MM H OR HD (CHEMICAL AGENTS) M110
1320-D568	PROJ	11	155MM GAS VX OR GB (CHEMICAL AGENTS) M121A1
	PROP	12a	25 MM BUSHMASTER
	PROP	12a	2680 DQ
	PROP	12a	37MM SMOKELESS
	PROP	12a	AA2
	PROP	12a	ABL 2776 CASTING POWDER
	PROP	12a	AHH CASTING POWDER
	PROP	12a	ARP CASTING POWDER
	PROP	12a	BALL POWDER
	PROP	12a	BENITE
	PROP	12a	BERMITE GRAIN
	PROP	12a	BLACK POWDER
	PROP	12a	BS-NACO
	PROP	12a	CBI POWDER
	PROP	12a	CMR 100 SMOKELESS BLACK POWDER
	PROP	12a	CR 8325
	PROP	12a	DIGL-RP
	PROP	12a	DRAW. NO. 9215128
	PROP	12a	DUAL-BASE SMOKELESS POWDER
	PROP	12a	FLASH POWDER
	PROP	12a	HDDR-A
	PROP	12a	HI-SKOR 700X

ITEM SUMMARY BY CLASS

TYPE OF ROUND	CLASS	DESCRIPTION
PROP	12a	HPC 1
PROP	12a	HPC 18
PROP	12a	HPC 2
PROP	12a	HPC 23
PROP	12a	HPC 4
PROP	12a	HPC 5
PROP	12a	HPC 8
PROP	12a	I 5420
PROP	12a	IMR 4198
PROP	12a	IMR 4475
PROP	12a	IMR 4831
PROP	12a	IMR 4895
PROP	12a	IMR 5010
PROP	12a	IMR 7013
PROP	12a	IMR 7383
PROP	12a	IMR 8097
PROP	12a	IMR 8138M
PROP	12a	IMR 8208M
PROP	12a	IMR A2
PROP	12a	JA 2
PROP	12a	M 1
PROP	12a	M 10
PROP	12a	M 12

ITEM SUMMARY BY CLASS

TYPE OF ROUND	CLASS	DESCRIPTION
PROP	12a	M 13
PROP	12a	M 14
PROP	12a	M 15
PROP	12a	M 16
PROP	12a	M 17
PROP	12a	M 17E1
PROP	12a	M 18
PROP	12a	M 1A1
PROP	12a	M 2
PROP	12a	M 21
PROP	12a	M 26
PROP	12a	M 26E1
PROP	12a	M 30
PROP	12a	M 30A1
PROP	12a	M 30A2
PROP	12a	M 30E1
PROP	12a	M 31
PROP	12a	M 31A1
PROP	12a	M 31T23
PROP	12a	M 33
PROP	12a	M 37
PROP	12a	M 5
PROP	12a	M 6

ITEM SUMMARY BY CLASS

TYPE OF ROUND	CLASS	DESCRIPTION
PROP	12a	M 6 + 2
PROP	12a	M 7
PROP	12a	M 7 LAW UNIT
PROP	12a	M 8
PROP	12a	M 9
PROP	12a	MK 43
PROP	12a	N 12
PROP	12a	N 12 HIGH ENERGY
PROP	12a	N 14
PROP	12a	N 4
PROP	12a	N 5
PROP	12a	N 8
PROP	12a	NOSIH-AM-2
PROP	12a	NOSOL-18
PROP	12a	PNJ CASTING POWDER
PROP	12a	ROLAND II BOOSTER
PROP	12a	SINGLE-BASE SMOKELESS POWDER
PROP	12a	SR 4759
PROP	12a	SR 4990
PROP	12a	SR 7325
PROP	12a	SR 7641
PROP	12a	SR 7970
PROP	12a	SR 8074

ITEM SUMMARY BY CLASS

TYPE OF ROUND	CLASS	DESCRIPTION
PROP	12a	SR 8231
PROP	12a	T 2
PROP	12a	T 25
PROP	12a	T 3
PROP	12a	T 5
PROP	12a	T 6
PROP	12a	T 8
PROP	12a	T 9
PROP	12a	WC 140
PROP	12a	WC 150
PROP	12a	WC 665
PROP	12a	WC 740
PROP	12a	WC 814
PROP	12a	WC 818
PROP	12a	WC 820
PROP	12a	WC 830
PROP	12a	WC 844
PROP	12a	WC 846
PROP	12a	WC 852
PROP	12a	WC 860
PROP	12a	WC 870
PROP	12a	WC 872
PROP	12a	WC 875

ITEM SUMMARY BY CLASS

	TYPE OF ROUND	CLASS	DESCRIPTION
	PROP	12a	WC BLANK
1315-C019	CHG	12b	PROP F/81MM
1315-C021	CHG	12b	PROP INCREMENT A M90A1 F/81MM MORTAR
1315-C022	CHG	12b	PROP INCREMENT B M90A1 F/81MM MORTAR
1315-C436	CHG	12b	PROP 105MM M7
1315-C709	CHG	12b	M6 PROPELLANT CHARGE FOR 4.2 IN MORTAR
1320-D532	CHG	12b	PROP 155MM RB M203 SERIES
1320-D533	CHG	12b	PROP 155MM RB M119 SERIES W/O PRIMER
1320-D534	CHG	12b	PROP 155MM WB M119/119E4 W/PRIMER
1320-D540	CHG	12b	PROP 155MM GB M3 SERIES
1320-D541	CHG	12b	PROP 155MM WB M4 SERIES
1320-D552	REDUCER	12b	FLASH M2 F/155MM PROP CHG
1320-D662	CHG	12b	PROP 8 IN WB M188A1 W/O PRIMER
1320-D675	CHG	12b	PROP 8 IN GB M1
1320-D676	CHG	12b	PROP 8 IN WB M2
1305-A899	CTG	14	20MM FIRING CIRCUIT TEST MK109 MOD 0
1320-D681	RDCR	14	FLASH M3 F/8-IN PROP CHARGE
1370-L377	SIM	14	DETONATION EXPL MK2 MOD 0

APPENDIX C-2

ARMY-WIDE ENERGETIC MATERIAL ITEMS CHEMICAL COMPOSITION DATA BASE

Table 4.1.2.2-2. Summary of combustion by-products default emission factors - metals (lb emitted per lb NEW)

Metals	OB[a] (Families 5, 12a and 12b)		OB[a] (Families 1b, 1c, 3-5, 9, 10, 12a and 12b)		OD (Families lb, 2-4, 6-11, and 14)	
	Short-term (≤ 24 hr)	Long-term (> 24 hr)	Short-term (≤ 24 hr)	Long-term (> 24 hr)	Short-term (≤ 24 hr)	Long-term (> 24 hr)
Arsenic[b]	-	-	-	-	-	--
Aluminum	4.0E-1	6.4E-3	4.0E-1	5.6E-3	2.0E-1	9.5E-3
Antimony[b]	-	-	5.0E-1	4.5E-1	2.2E-2	2.0E-4
Barium	3.0E-1	2.9E-3	4.1E-1	7.6E-3	4.1E-1	3.6E-3
Boron[b]	1.0E-3	1.0E-5	4.1E-3	1.0E-5	5.5E-3	7.0E-5
Calcium	5.0E-3	5.3E-4	8.3E-2	7.4E-4	3.5E-2	5.2E-4
Chromium	-	-	-	-	-	-
Copper	1.0E-2	7.0E-5	1.0E-2	3.0E-5	-	-
Iron	-	-	7.0E-2	3.0E-4	7.0E-2	3.9E-4
Lead	3.0E-2	4.5E-3	8.1E-1	2.6E-2	8.1E-1	1.2E-2
Manganese	-	-	-	-	-	-
Magnesium	1.0E-3	1.0E-5	4.5E-1	6.3E-3	4.5E-1	9.2E-3
Nickel	-	-	6.1E-2	1.8E-4	6.1E-2	2.4E-4
Potassium	8.7E-1	3.6E-2	8.7E-1	6.1E-2	7.5E-1	4.6E-2
Silver[b]	1.0E-2	7.0E-5	1.0E-2	3.0E-5	-	-
Sodium	3.0E-3	3.1E-4	1.0E+0	1.2E-2	1.0E+0	1.9E-2
Strontium[b]	-	-	1.1E-1	8.0E-4	1.1E-1	1.0E-3
Tin[b]	1.1E-2	3.4E-2	1.3E-2	4.2E-4	1.3E-2	3.8E-4
Titanium[b]	-	-	7.0E-2	1.8E-4	7.0E-2	2.4E-4
Zinc	-	-	5.4E-1	1.4E-3	5.4E-1	7.9E-3

[a]Includes families (1b, 1c, 3, 4, 9, and 10) which are candidates for OB, although OD is the preferred treatment method.
[b]Not a routine treatment constituent (use only as applicable).

Table 4.1.2.2-4. Summary of combustion by-products default emission factors - energetics (lb emitted per lb NEW)

	OB (Families 5, 12a and 12b)		OB[a] (Families 1b, 1c, 3-5, 9, 10, 12a and 12b)		OD (Families lb, 2-4, 6-11, and 14)	
	Short term	Long term	Short term	Long term	Short term	Long term
RDX	1.0E-6	7.2E-9	1.0E-6	1.1E-7	4.0E-4	4.5E-5
HMX	1.6E-7	2.2E-9	2.0E-7	1.4E-9	3.8E-4	3.0E-5
TNT	--	--	1.0E-6	4.4E-8	4.0E-4	1.5E-5
TNG	4.9E-7	1.5E-7	4.9E-7	7.5E-8	1.6E-4	2.6E-6
DIMP	-	-	-	-	-	-
DNT	1.3E-7	3.2E-8	1.3E-7	3.2E-8	4.0E-5	2.2E-6
DNB	-	-	-	-	-	-
HCE	-	-	-	-	1.8E-4	5.8E-7
WP[b]	-	-	8.3E-7	2.2E-9	4.0E-4	2.8E-6
Picric Acid	-	-	-	-	-	-
NG	5.5E-7	4.0E-8	5.5E-7	3.6E-8	2.2E-4	2.8E-6
Tetryl	-	-	1.0E-6	1.6E-8	4.0E-4	2.6E-6
TNB	-	-	1.4E-8	8.8E-9	9.1E-7	1.8E-7
Total	2.3E-6	2.1E-7	5.2E-6	3.6E-7	2.6E-3	4.7E-5

RDX - Cyclo-1,3,5-trimethylene-2,4,6-trinitramine
HMX - Cyclotetramethylene tetranitramine
TNT - Trinitrotoluene
TNG - Trinitroglycerol (Nitroglycerin)
DIMP - Diisopropyl methylphosphonate
DNT - 2,4- and 2,6-Dinitrotoluene
DNB - 1,3-Dinitrobenzen
HCE - Hexachloroethane
WP - White phosphorus
NG - Nitroguanidine
Tetryl - Trinitro-2,4,6-phenylmethylnitramine
TNB - 1,3,5 Tinitrobenzo

[a]Includes families (1b, 1c, 3, 4, 9, and 10) which are candidates for OB, although OD is the preferred treatment method.
[b]Not a routine treatment constituent (use only as applicable).

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	25 MM BUSHMASTER	DINITROTOLUENE		3.1
		DIPHENYLAMINE		0.9
		GRAPHITE		0.4
		NITROCELLULOSE		94.6
		POTASSIUM NITRATE		1
	2680 DQ	NITROCELLULOSE		25
		RESORCINOL		1.5
		2-NITRODIPHENYLAMINE		1
		AMMONIUM PERCHLORATE		50
		ALUMINUM		10
		NITROGLYCERIN		12.5
	37MM SMOKELESS	BARIUM NITRATE		1.4
		ETHYL CENTRALITE		0.6
		GRAPHITE		0.3
		NITROCELLULOSE		77.5
		NITROGLYCERIN		19.5
		POTASSIUM NITRATE		0.8
	AA2	DI-N-PROPYL ADIPATE		1.6
		TRIACETIN		2.7
		NITROGLYCERIN		38.6

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	AA2	2-NITRODIPHENYLAMINE		2
		NITROCELLULOSE		51
		MONOBASIC CU SALICYLATE		2
		LEAD 3-RESORCYLATE		0.5
		CANDELILLA WAX		0.1
		LEAD SALICYLATE		1.5
	ABL 2776 CASTING POWDER	NITROGLYCERIN		10
		RESORCINOL		1.7
		ALUMINUM		10
		AMMONIUM PERCHLORATE		49.8
		2-NITRODIPHENYLAMINE		1
		NITROCELLULOSE		27.6
	AHH CASTING POWDER	NITROGLYCERIN		11.4
		2-NITRODIPHENYLAMINE		1
		NITROCELLULOSE		83
		LEAD 2-ETHYLHEXOATE		2.3
		LEAD SALICYLATE		2.3
	ARP CASTING POWDER	NITROGLYCERIN		16.9
		2-NITRODIPHENYLAMINE		2
		NITROCELLULOSE		74.8

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	ARP CASTING POWDER	LEAD SALICYLATE		3
		CARBON BLACK		0.3
		LEAD 3-RESORCYLATE		3
	BALL POWDER	NITROCELLULOSE		79
		DIPHENYLAMINE		1
		DIBUTYLPHTHALATE		5
		NITROGLYCERIN		15
	BENITE	SULFUR		6.3
		POTASSIUM NITRATE		44.1
		NITROCELLULOSE		39.8
		ETHYL CENTRALITE		0.5
		CHARCOAL		9.4
	BERMITE GRAIN	NITROGLYCERIN		31
		ETHYL CENTRALITE		2
		LEAD SALICYLATE		2.5
		LEAD STEARATE		0.5
		NITROCELLULOSE		53
		TRIACETIN		11
	BLACK POWDER	POTASSIUM NITRATE		75
		SULFUR		10

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	BLACK POWDER	CHARCOAL		15
	BS-NACO	POTASSIUM SULFATE		1.3
		ETHYL CENTRALITE		1.2
		GRAPHITE		0.1
		LEAD CARBONATE		1
		NITROCELLULOSE		93.6
		N-BUTYL STEARATE		3
	CBI POWDER	POTASSIUM NITRATE		0.1
		NITROCELLULOSE		98.2
		GRAPHITE		0.2
		DIPHENYLAMINE		1.5
	CMR 100 SMOKELESS BLACK POWDER	DINITROTOLUENE		7
		DIPHENYLAMINE		0.9
		GRAPHITE		0.2
		NITROCELLULOSE		91.4
		POTASSIUM SULFATE		0.6
	CR 8325	DIPHENYLAMINE		0.9
		NITROCELLULOSE		95.4
		POTASSIUM SULFATE		0.6
		GRAPHITE		0.2

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	CR 8325	METHYL CENTRALITE		3
	DIGL-RP	NITROCELLULOSE		63.5
		NITROGLYCERIN		35.7
		MAGNESIUM OXIDE		0.1
		GRAPHITE		0.1
		CENTRALITE		0.3
		AKARDITE		0.5
	DRAW. NO. 9215128	POTASSIUM SULFATE		1
		ETHYLENE DIMETHACRYLATE		3.1
		GRAPHITE		0.3
		DIPHENYLAMINE		0.7
		NITROCELLULOSE		95
	DUAL-BASE SMOKELESS POWDER	NITROCELLULOSE		62
		NITROGLYCERIN		38
	FLASH POWDER	ALUMINUM		40
		POTASSIUM PERCHLORATE		30
		BARIUM NITRATE		30
	HDDR-A	AMMONIUM PERCHLORATE		15
		RESORCINOL		1.7
		HMX		15

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	HDDR-A	NITROCELLULOSE		30
		ALUMINUM		27.5
		2-NITRODIPHENYLAMINE		1
		NITROGLYCERIN		10
	HI-SKOR 700X	NITROGLYCERIN		27
		NITROCELLULOSE		73
	HPC 1	GRAPHITE		0.2
		POTASSIUM SULFATE		1.3
		NITROCELLULOSE		59.1
		ETHYL CENTRALITE		0.8
		NITROGLYCERIN		38.8
	HPC 18	ETHYL CENTRALITE		1.1
		POTASSIUM SULFATE		1
		POTASSIUM NITRATE		1
		NITROGLYCERIN		20.1
		CARBON BLACK		0.5
		GRAPHITE		0.5
		NITROCELLULOSE		75.8
	HPC 2	DIPHENYLAMINE		1
		GRAPHITE		0.2

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	HPC 2	ETHYL CENTRALITE		2.5
		NITROCELLULOSE		81.4
		NITROGLYCERIN		15
	HPC 23	NITROCELLULOSE		58.7
		GRAPHITE		0.3
		ETHYL CENTRALITE		1.1
		NITROGLYCERIN		40
	HPC 4	POTASSIUM SULFATE		1
		GRAPHITE		0.2
		NITROCELLULOSE		74.8
		ETHYL CENTRALITE		1
		DIPHENYLAMINE		1.3
		CORN STARCH		1.8
		NITROGLYCERIN		19.9
	HPC 5	NITROGLYCERIN		15
		DIPHENYLAMINE		1
		ETHYL CENTRALITE		4
		NITROCELLULOSE		79.9
		GRAPHITE		0.2
	HPC 8	DIPHENYLAMINE		1

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	HPC 8	NITROGLYCERIN		15
		NITROCELLULOSE		78.4
		GRAPHITE		0.2
		ETHYL CENTRALITE		5.5
	I 5420	NITROCELLULOSE		62.5
		ETHYL CENTRALITE		0.4
		DIETHYLENE GLYCOL DINITRATE		36.7
		AKARDITE		0.5
	IMR 4198	POTASSIUM SULFATE		0.6
		NITROCELLULOSE		92.4
		DIPHENYLAMINE		0.9
		DINITROTOLUENE		6
		GRAPHITE		0.2
	IMR 4475	DINITROTOLUENE		8
		DIPHENYLAMINE		0.9
		GRAPHITE		0.2
		NITROCELLULOSE		90.4
		POTASSIUM SULFATE		0.6
	IMR 4831	DINITROTOLUENE		7.5
		DIPHENYLAMINE		0.9

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	IMR 4831	GRAPHITE		0.2
		NITROCELLULOSE		90.9
		POTASSIUM SULFATE		0.6
	IMR 4895	DINITROTOLUENE		7
		POTASSIUM SULFATE		0.6
		DIPHENYLAMINE		0.9
		NITROCELLULOSE		91.3
		GRAPHITE		0.2
	IMR 5010	DINITROTOLUENE		8.3
		DIPHENYLAMINE		0.9
		GRAPHITE		0.2
		NITROCELLULOSE		90
		POTASSIUM SULFATE		0.6
	IMR 7013	POTASSIUM SULFATE		0.6
		TIN		0.7
		NITROCELLULOSE		90.2
		GRAPHITE		0.2
		DIPHENYLAMINE		0.9
		DINITROTOLUENE		7.5
	IMR 7383	DINITROTOLUENE		11.5

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	IMR 7383	DIPHENYLAMINE		0.8
		GRAPHITE		0.2
		NITROCELLULOSE		83.9
		POTASSIUM SULFATE		0.6
		DIBUTYLPHTHALATE		3
	IMR 8097	DINITROTOLUENE		2.5
		POTASSIUM SULFATE		0.6
		DIPHENYLAMINE		0.9
		NITROCELLULOSE		95.8
		GRAPHITE		0.2
	IMR 8138M	DIPHENYLAMINE		0.9
		ETHYLENE DIMETHACRYLATE		5
		GRAPHITE		0.2
		NITROCELLULOSE		93.4
		POTASSIUM SULFATE		0.6
	IMR 8208M	ETHYLENE DIMETHACRYLATE		5
		POTASSIUM SULFATE		0.6
		GRAPHITE		0.2
		DIPHENYLAMINE		0.9
		NITROCELLULOSE		93.4

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	IMR A2	POTASSIUM SULFATE		1
		DIPHENYLAMINE		0.7
		DINITROTOLUENE		7.9
		NITROCELLULOSE		90.4
	JA 2	AKARDITE		0.7
		DIETHYLENE GLYCOL DINITRATE		21.7
		GRAPHITE		0.1
		MAGNESIUM OXIDE		0.1
		NITROCELLULOSE		63.5
		NITROGLYCERIN		14
	M 1	DINITROTOLUENE		10
		DIPHENYLAMINE		1
		DIBUTYLPHTHALATE		5
		NITROCELLULOSE		85
	M 10	GRAPHITE		0.1
		NITROCELLULOSE		98
		POTASSIUM SULFATE		1
		DIPHENYLAMINE		1
	M 12	TIN		0.7
		POTASSIUM SULFATE		0.7

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	M 12	NITROCELLULOSE		90.4
		DINITROTOLUENE		7.4
		DIPHENYLAMINE		0.7
	M 13	NITROCELLULOSE		57.3
		POTASSIUM SULFATE		1.5
		ETHYL CENTRALITE		1
		DIPHENYLAMINE		0.8
		CARBON BLACK		0.1
		NITROGLYCERIN		40
	M 14	DIBUTYLPHTHALATE		2
		DINITROTOLUENE		8
		DIPHENYLAMINE		1
		NITROCELLULOSE		90
	M 15	CRYOLITE		0.3
		NITROGLYCERIN		19
		ETHYL CENTRALITE		6
		NITROGUANIDINE		54.7
		NITROCELLULOSE		20
	M 16	LEAD STEARATE		0.5
		NITROGLYCERIN		27.7

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	M 16	NITROCELLULOSE		55
		POTASSIUM SULFATE		1.6
		ETHYL CENTRALITE		4
		CARBON BLACK		0.5
		DINITROTOLUENE		10.7
	M 17	ETHYL CENTRALITE		1.5
		GRAPHITE		0.1
		CRYOLITE		0.3
		NITROGLYCERIN		21.5
		NITROGUANIDINE		54.7
		NITROCELLULOSE		22
	M 17E1	ETHYL CENTRALITE		1.5
		GRAPHITE		0.1
		NITROCELLULOSE		22.2
		NITROGLYCERIN		21.7
		NITROGUANIDINE		54.5
	M 18	DIBUTYLPHTHALATE		9
		NITROGLYCERIN		10
		NITROCELLULOSE		80
		DIPHENYLAMINE		1

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	M 1A1	DIPHENYLAMINE		1
		NITROCELLULOSE		84.5
		DIBUTYLPHTHALATE		4.5
		DINITROTOLUENE		10
	M 2	ETHYL CENTRALITE		0.6
		POTASSIUM NITRATE		0.8
		GRAPHITE		0.3
		NITROCELLULOSE		77.5
		NITROGLYCERIN		19.5
		BARIUM NITRATE		1.4
	M 21	TRIACETIN		11
		ETHYL CENTRALITE		2
		LEAD SALICYLATE		2.5
		LEAD STEARATE		0.5
		NITROGLYCERIN		31
		NITROCELLULOSE		53
	M 26	BARIUM NITRATE		0.8
		POTASSIUM NITRATE		0.7
		NITROGLYCERIN		25
		NITROCELLULOSE		67.3

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	M 26	ETHYL CENTRALITE		6
		GRAPHITE		0.3
	M 26E1	NITROGLYCERIN		25
		ETHYL CENTRALITE		6
		NITROCELLULOSE		68.7
		GRAPHITE		0.3
	M 30	NITROGUANIDINE		47.7
		CRYOLITE		0.3
		ETHYL CENTRALITE		1.5
		GRAPHITE		0.1
		NITROCELLULOSE		28
		NITROGLYCERIN		22.5
	M 30A1	NITROCELLULOSE		28
		POTASSIUM SULFATE		1
		NITROGLYCERIN		22.5
		ETHYL CENTRALITE		1.5
		NITROGUANIDINE		47
	M 30A2	NITROCELLULOSE		27.1
		POTASSIUM NITRATE		2.8
		ETHYL CENTRALITE		1.3

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	M 30A2	NITROGLYCERIN		22.6
		NITROGUANIDINE		46.3
	M 30E1	NITROCELLULOSE		27
		NITROGLYCERIN		22.5
		NITROGUANIDINE		46.3
		POTASSIUM NITRATE		2.8
		ETHYL CENTRALITE		1.5
	M 31	NITROGLYCERIN		19
		DIBUTYLPHTHALATE		4.5
		NITROCELLULOSE		20
		CRYOLITE		0.3
		NITROGUANIDINE		54.7
		ETHYL CENTRALITE		1.5
	M 31A1	DIBUTYLPHTHALATE		4.5
		NITROCELLULOSE		20
		2-NITRODIPHENYLAMINE		1.5
		NITROGLYCERIN		19
		NITROGUANIDINE		54
		POTASSIUM SULFATE		1
	M 31T23	NITROCELLULOSE		18.6

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	M 31T23	POTASSIUM SULFATE		1.4
		POTASSIUM NITRATE		0.6
		NITROGLYCERIN		17.7
		ETHYL CENTRALITE		5.6
		DIPHENYLAMINE		0.9
		DIBUTYLPHTHALATE		4.2
		BARIUM NITRATE		0.7
		NITROGUANIDINE		50.3
	M 33	NITROCELLULOSE		50
		TRIACETIN		9.7
		2-NITRODIPHENYLAMINE		1
		LEAD SALICYLATE		1.5
		LEAD 2-ETHYLHEXOATE		1.5
		CANDELILLA WAX		0.1
		NITROGLYCERIN		36.2
	M 37	LEAD 2-ETHYLHEXOATE		1.5
		NITROGLYCERIN		36.2
		TRIACETIN		9.7
		2-NITRODIPHENYLAMINE		1
		CANDELILLA WAX		0.1

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	M 37	NITROCELLULOSE		50
		LEAD SALICYLATE		1.5
	M 5	BARIUM NITRATE		1.4
		ETHYL CENTRALITE		0.6
		GRAPHITE		0.3
		NITROCELLULOSE		82
		NITROGLYCERIN		15
		POTASSIUM NITRATE		0.8
	M 6	NITROCELLULOSE		87
		DIBUTYLPHTHALATE		3
		DINITROTOLUENE		10
		DIPHENYLAMINE		1
	M 6 + 2	NITROCELLULOSE		86
		DINITROTOLUENE		9
		DIBUTYLPHTHALATE		3
		POTASSIUM SULFATE		2
	M 7	ETHYL CENTRALITE		0.9
		NITROCELLULOSE		54.6
		NITROGLYCERIN		35.5
		POTASSIUM PERCHLORATE		7.8

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	M 7	CARBON BLACK		1.2
	M 7 LAW UNIT	POTASSIUM PERCHLORATE		7.8
		ETHYL CENTRALITE		0.9
		NITROCELLULOSE		58.7
		NITROGLYCERIN		32
		CARBON BLACK		0.6
	M 8	DIETHYLPHTHALATE		3
		ETHYL CENTRALITE		0.6
		NITROCELLULOSE		52.2
		NITROGLYCERIN		43
		POTASSIUM NITRATE		1.3
	M 9	ETHYL CENTRALITE		0.8
		NITROGLYCERIN		40
		POTASSIUM NITRATE		1.5
		NITROCELLULOSE		57.8
	MK 43	CANDELILLA WAX		0.2
		DIETHYLPHTHALATE		10.5
		LEAD 2-ETHYLHEXOATE		1.2
		LEAD SALICYLATE		1.2
		NITROCELLULOSE		50

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	MK 43	2-NITRODIPHENYLAMINE		2
		NITROGLYCERIN		34.9
	N 12	NITROGLYCERIN		38
		2-NITRODIPHENYLAMINE		2
		NITROCELLULOSE		50
		LEAD 2,4-DIHYDROXYBENZOATE		2
		CANDELILLA WAX		0.2
		CUPRIC SALICYLATE		2
		DI-N-PROPYL ADIPATE		5.9
	N 12 HIGH ENERGY	DI-N-PROPYL ADIPATE		3.5
		NITROGLYCERIN		40.6
		2-NITRODIPHENYLAMINE		2
		NITROCELLULOSE		48.8
		LEAD 2,4-DIHYDROXYBENZOATE		2.5
		CANDELILLA WAX		0.1
		CUPRIC SALICYLATE		2.5
	N 14	CANDELILLA WAX		0.1
		NITROGLYCERIN		44.5
		2-NITRODIPHENYLAMINE		2
		NITROCELLULOSE		48

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	N 14	DI-N-PROPYL ADIPATE		0.4
		CUPRIC SALICYLATE		2.5
		LEAD 3-RESORCYLATE		2.5
	N 4	CARBON BLACK		0.1
		NITROGLYCERIN		34.6
		DIETHYLPHTHALATE		10.9
		2-NITRODIPHENYLAMINE		2.1
		NITROCELLULOSE		51
		POTASSIUM SULFATE		0.8
		LEAD STEARATE		0.5
	N 5	LEAD 2-ETHYLHEXOATE		1.2
		NITROGLYCERIN		34.9
		2-NITRODIPHENYLAMINE		2
		LEAD SALICYLATE		1.2
		DIETHYLPHTHALATE		10.5
		NITROCELLULOSE		50
		CANDELILLA WAX		0.2
	N 8	DIETHYLPHTHALATE		6.7
		CARBON BLACK		0.1
		NITROCELLULOSE		49.5

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	N 8	CANDELILLA WAX		0.1
		NITROGLYCERIN		37.6
		LEAD 2,4-DIHYDROXYBENZOATE		2
		LEAD SALICYLATE		2
		2-NITRODIPHENYLAMINE		2
	NOSIH-AM-2	NITROGLYCERIN		44.2
		CANDELILLA WAX		0.1
		ALUMINUM		2.5
		CUPRIC SALICYLATE		2.5
		DI-N-PROPYL ADIPATE		1.2
		LEAD 3-RESORCYLATE		2.5
		2-NITRODIPHENYLAMINE		2
		NITROCELLULOSE		45
	NOSOL-18	NITROCELLULOSE		46
		LEAD CARBONATE		1
		TRIETHYLENE GLYCOL DINITRATE		3
		CANDELILLA WAX		0.1
		ETHYL CENTRALITE		2
		METRIOTRINITRATE		38.5
		DIBUTYLPHTHALATE		8.1

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	NOSOL-18	POTASSIUM SULFATE		1.3
	PNJ CASTING POWDER	LEAD SALICYLATE		2.9
		POTASSIUM SULFATE		0.8
		2-NITRODIPHENYLAMINE		1.9
		NITROGLYCERIN		16.5
		LEAD 2,4-DIHYDROXYBENZOATE		2.9
		GRAPHITE		0.2
		CARBON BLACK		0.2
		NITROCELLULOSE		74.5
	ROLAND II BOOSTER	NITROGLYCERIN		33.2
		ACETYLENE		1
		CRYOLITE		0.6
		DIETHYLPHTHALATE		5.8
		LEAD STEARATE		2.5
		NITROCELLULOSE		54.2
		2-NITRODIPHENYLAMINE		1.7
		COPPER CHROMITE		1
	SINGLE-BASE SMOKELESS POWDER	CELLULOSE		15
		NITROCELLULOSE		85
	SR 4759	NITROCELLULOSE		96.4

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	SR 4759	POTASSIUM NITRATE		2
		GRAPHITE		0.2
		DIPHENYLAMINE		0.9
		POTASSIUM SULFATE		0.6
	SR 4990	NITROCELLULOSE		93.2
		POTASSIUM NITRATE		2.3
		BARIUM CARBONATE		0.5
		BARIUM NITRATE		3
		DIPHENYLAMINE		0.9
		GRAPHITE		0.2
	SR 7325	NITROCELLULOSE		97
		GRAPHITE		0.2
		DINITROTOLUENE		2
		DIPHENYLAMINE		0.9
	SR 7641	DINITROTOLUENE		4
		DIPHENYLAMINE		0.9
		GRAPHITE		0.3
		NITROCELLULOSE		94.4
		POTASSIUM NITRATE		0.6
	SR 7970	NITROCELLULOSE		96.5

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	SR 7970	DINITROTOLUENE		2.5
		DIPHENYLAMINE		0.9
		GRAPHITE		0.2
	SR 8074	DIPHENYLAMINE		0.9
		GRAPHITE		0.2
		DINITROTOLUENE		4
		NITROCELLULOSE		95
	SR 8231	NITROCELLULOSE		96
		POTASSIUM SULFATE		0.5
		GRAPHITE		0.2
		DIPHENYLAMINE		0.9
		DINITROTOLUENE		2.5
	T 2	DINITROTOLUENE		2.5
		NITROCELLULOSE		58
		ETHYL CENTRALITE		8
		POTASSIUM SULFATE		1.5
		NITROGLYCERIN		30
	T 25	BARIUM NITRATE		0.8
		NITROGLYCERIN		20
		POTASSIUM NITRATE		0.7

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	T 25	NITROCELLULOSE		73.3
		GRAPHITE		0.3
		ETHYL CENTRALITE		5
	T 3	DINITROTOLUENE		9.3
		LEAD STEARATE		0.5
		METHYL CELLULOSE		0.1
		NITROGLYCERIN		27
		NITROCELLULOSE		56
		ETHYL CENTRALITE		7.2
	T 5	CARBON BLACK		0.1
		LEAD STEARATE		0.1
		NITROCELLULOSE		57.5
		NITROGLYCERIN		39.2
		POTASSIUM SULFATE		1.5
		ETHYL CENTRALITE		1.8
	T 6	NITROGLYCERIN		27.5
		NITROCELLULOSE		55.5
		LEAD STEARATE		0.5
		ETHYL CENTRALITE		4
		DINITROTOLUENE		10.5

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	T 6	CARBON BLACK		0.5
		POTASSIUM SULFATE		1.5
	T 8	DINITROTOLUENE		2.5
		NITROGLYCERIN		22.5
		NITROCELLULOSE		58
		ETHYL CENTRALITE		8
		TRIACETIN		8.5
		LEAD STEARATE		0.5
	T 9	POTASSIUM NITRATE		49.8
		AMMONIUM PICRATE		40.7
		ETHYL CELLULOSE		4.5
		CALCIUM STEARATE		0.5
		CHLORINATED WAX		4.5
	WC 140	NITROGLYCERIN		0.5
		CALCIUM CARBONATE		0.5
		DIBUTYLPHTHALATE		1
		SODIUM SULFATE		0.3
		DIPHENYLAMINE		1.2
		GRAPHITE		0.2
		NITROCELLULOSE		96.3

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	WC 150	CALCIUM CARBONATE		0.5
		DIBUTYLPHTHALATE		1
		DIPHENYLAMINE		1.2
		GRAPHITE		0.2
		NITROCELLULOSE		87.5
		NITROGLYCERIN		9.5
		SODIUM SULFATE		0.3
	WC 665	GRAPHITE		0.2
		NITROCELLULOSE		84.7
		DIPHENYLAMINE		1.2
		DIBUTYLPHTHALATE		4
		NITROGLYCERIN		10
	WC 740	CALCIUM CARBONATE		0.5
		DIBUTYLPHTHALATE		5.5
		DIPHENYLAMINE		1.2
		GRAPHITE		0.2
		NITROCELLULOSE		82.2
		NITROGLYCERIN		9.5
		POTASSIUM NITRATE		0.8
		SODIUM SULFATE		0.3

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	WC 814	NITROGLYCERIN		16
		SODIUM SULFATE		0.3
		GRAPHITE		0.2
		NITROCELLULOSE		79.9
		DIPHENYLAMINE		1.2
		CALCIUM CARBONATE		0.2
		DIBUTYLPHTHALATE		0.5
		DIPHENYLPHTHALATE		2
	WC 818	CALCIUM CARBONATE		0.5
		DIBUTYLPHTHALATE		0.8
		DIPHENYLAMINE		1.2
		GRAPHITE		0.2
		NITROCELLULOSE		87
		NITROGLYCERIN		10
		SODIUM SULFATE		0.3
	WC 820	GRAPHITE		0.2
		SODIUM SULFATE		0.3
		NITROCELLULOSE		85.5
		DIBUTYLPHTHALATE		3
		NITROGLYCERIN		9.5

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	WC 820	CALCIUM CARBONATE		0.5
		DIPHENYLAMINE		1.2
	WC 830	GRAPHITE		0.2
		POTASSIUM SULFATE		0.8
		NITROCELLULOSE		74.2
		DIPHENYLAMINE		1.2
		DIBUTYLPHTHALATE		4
		CALCIUM CARBONATE		0.5
		SODIUM SULFATE		0.3
		NITROGLYCERIN		19
	WC 844	DIPHENYLAMINE		1.1
		NITROGLYCERIN		10.2
		NITROCELLULOSE		84
		SODIUM SULFATE		0.1
		CALCIUM CARBONATE		0.1
		DINITROTOLUENE		0.7
		DIBUTYLPHTHALATE		3.9
	WC 846	CALCIUM CARBONATE		0.5
		DIBUTYLPHTHALATE		5.3
		DIPHENYLAMINE		1.2

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	WC 846	GRAPHITE		0.2
		NITROCELLULOSE		83
		NITROGLYCERIN		9.5
		SODIUM SULFATE		0.3
	WC 852	CALCIUM CARBONATE		0.5
		SODIUM SULFATE		0.3
		POTASSIUM NITRATE		0.8
		NITROGLYCERIN		9.5
		NITROCELLULOSE		82.2
		GRAPHITE		0.2
		DIBUTYLPHTHALATE		5.5
		DIPHENYLAMINE		1.2
	WC 860	POTASSIUM NITRATE		0.3
		SODIUM SULFATE		0.3
		NITROGLYCERIN		9.5
		DIBUTYLPHTHALATE		8
		NITROCELLULOSE		80.2
		CALCIUM CARBONATE		0.5
		DIPHENYLAMINE		1.1
		GRAPHITE		0.2

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	WC 870	POTASSIUM NITRATE		0.8
		SODIUM SULFATE		0.3
		CALCIUM CARBONATE		0.5
		DIBUTYLPHTHALATE		6.5
		DIPHENYLAMINE		1.2
		GRAPHITE		0.2
		NITROCELLULOSE		80.1
		NITROGLYCERIN		9.5
		TIN DIOXIDE		1.1
	WC 872	NITROGLYCERIN		9.6
		SODIUM SULFATE		0.3
		TIN DIOXIDE		1.1
		CALCIUM CARBONATE		0.5
		GRAPHITE		0.2
		NITROCELLULOSE		79.6
		DIBUTYLPHTHALATE		7.5
		DIPHENYLAMINE		1.2
	WC 875	TIN DIOXIDE		1.1
		SODIUM SULFATE		0.3
		POTASSIUM NITRATE		0.8

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
	WC 875	NITROGLYCERIN		9.5
		NITROCELLULOSE		79.1
		GRAPHITE		0.2
		DIPHENYLAMINE		1.2
		DIBUTYLPHTHALATE		7.5
		CALCIUM CARBONATE		0.5
	WC BLANK	DIPHENYLAMINE		1.2
		DIBUTYLPHTHALATE		1.5
		NITROCELLULOSE		86.7
		NITROGLYCERIN		10
		SODIUM SULFATE		0.3
		CALCIUM CARBONATE		0.5
1305-A066	5.56MM BALL M193 CTN PACK	ANTIMONY SULFIDE	0	0.22
		BARIUM NITRATE	0	0.46
		DIBUTYLPHTHALATE	0	3.8
		NITROCELLULOSE	0	87
		LEAD STYPHNATE	0	0.54
		NITROGLYCERIN	0	10.1
		DIPHENYLAMINE	0	0.9
		GRAPHITE	0	0.39

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A066	5.56MM BALL M193 CTN PACK	DINITROTOLUENE	0	0.7
		ETHYLENE DIMETHYLACRYLATE	0	3
1305-A068	5.56MM TR M195 CTN PACK	ALUMINUM POWDER	0.000004	0.1
		BARIUM NITRATE	0.000019	0.45
		ANTIMONY SULFIDE	0.000009	0.21
		LEAD STYPHNATE	0.000021	0.52
		PETN	0.000003	0.07
		TETRACENE	0.000003	0.07
		DINITROTOLUENE	0.000386	9.35
		DIPHENYLAMINE	0.00005	1.21
		NITROCELLULOSE	0.0036	87.17
		POTASSIUM SULFATE	0.000039	0.93
1305-A071	5.56MM BALL M193 10/CLIP	ALUMINUM POWDER	0.000004	0.11
		BARIUM NITRATE	0.000019	0.47
		ANTIMONY SULFIDE	0.000009	0.22
		NITROCELLULOSE	0.00324	82.65
		NITROGLYCERIN	0.000393	10.03
		LEAD STYPHNATE	0.000021	0.55
		DIPHENYLAMINE	0.000043	1.09
		DIBUTYLPHTHALATE	0.00015	3.83

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A071	5.56MM BALL M193 10/CLIP	DINITROTOLUENE	0.000027	0.69
		SODIUM SULFATE	0.000004	0.11
1305-A075	5.56MM BLANK M200 LNKD	ANTIMONY SULFIDE	0	0.8
		ALUMINUM POWDER	0	0.4
		BARIUM NITRATE	0	3.2
		LEAD STYPHNATE	0	2
		TETRACENE	0	0.3
		PETN	0	0.3
		DIPHENYLAMINE	0	0.8
		NITROCELLULOSE	0	77.6
		NITROGLYCERIN	0	14.2
		POTASSIUM NITRATE	0	0.5
1305-A080	5.56MM BLANK M200 SNGL RD	ANTIMONY SULFIDE	0	0.8
		BARIUM NITRATE	0	3.2
		ALUMINUM POWDER	0	0.4
		LEAD STYPHNATE	0	2
		PETN	0	0.3
		TETRACENE	0	0.3
		DIPHENYLAMINE	0	0.8
		NITROGLYCERIN	0	14.2

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A080	5.56MM BLANK M200 SNGL RD	NITROCELLULOSE	0	77.6
		POTASSIUM NITRATE	0	0.5
1305-A090	CAL .22 TR PRAC M861	BARIUM NITRATE	0.000023	5.31
		NITROGLYCERIN	0.000143	33.18
		GRAPHITE	0.000001	0.33
		ETHYL CENTRALITE	0.000006	1.32
		NITROCELLULOSE	0.000221	51.28
		POTASSIUM SULFATE	0.000007	1.65
		ANTIMONY SULFIDE	0.000004	1
		CALCIUM SILICIDE	0.000004	1
		LEAD STYPHNATE	0.00002	4.64
		TETRACENE	0.000001	0.33
1305-A111	7.62MM BLANK M82 LNKD	DIBUTYLPHTHALATE	0	0.7
		CALCIUM CARBONATE	0	0.5
		DINITROTOLUENE	0	2.4
		DIPHENYLAMINE	0	1
		NITROCELLULOSE	0	84
		NITROGLYCERIN	0	12.5
		ANTIMONY SULFIDE	0	0.5
		ETHYL CENTRALITE	0	2.4

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A111	7.62MM BLANK M82 LNKD	LEAD STYPHNATE	0	1.5
		BARIUM NITRATE	0	1.4
1305-A112	7.62MM BLANK M82 CTN PACK	CALCIUM CARBONATE	0	0.5
		DIPHENYLAMINE	0	1
		DINITROTOLUENE	0	2.4
		DIBUTYLPHTHALATE	0	0.7
		NITROCELLULOSE	0	84
		NITROGLYCERIN	0	12.5
		LEAD STYPHNATE	0	1.5
		ETHYL CENTRALITE	0	2.4
		ANTIMONY SULFIDE	0	0.5
		POTASSIUM SULFATE	0	0.5
1305-A122	7.62MM BALL M59/M80 CTN PACK	ANTIMONY SULFIDE	0	0.19
		DIBUTYLPHTHALATE	0	5
		BARIUM NITRATE	0	0.4
		NITROCELLULOSE	0	81.44
		LEAD STYPHNATE	0	0.48
		NITROGLYCERIN	0	9.5
		DIPHENYLAMINE	0	1
		CALCIUM CARBONATE	0	0.3

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A122	7.62MM BALL M59/M80 CTN PACK	DINITROTOLUENE	0	0.99
		SODIUM SULFIDE	0	0.49
1305-A124	7.62MM TR M62 CTN PACK	DIBUTYLPHTHALATE	0.000226	2.95
		NITROCELLULOSE	0.00563	73.5
		NITROGLYCERIN	0.000514	6.71
		MAGNESIUM POWDER	0.000301	3.92
		STRONTIUM	0.00066	8.61
		POLYVINYL CHLORIDE	0.00017	2.22
		BARIUM NITRATE	0.000022	0.28
		LEAD STYPHNATE	0.000031	0.41
		DIPHENYLAMINE	0.000051	0.67
		SODIUM SULFATE	0.000033	0.43
1305-A140		DIPHENYLAMINE	0	1
		DINITROTOLUENE	0	0.8
		DIBUTYLPHTHALATE	0	4.4
		NITROCELLULOSE	0	69
		NITROGLYCERIN	0	8
		STRONTIUM NITRATE	0	7.2
		LEAD STYPHNATE	0	0.4
		MAGNESIUM POWDER	0	3.7

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A140	7.62MM TR M62 CTN PACK	POLYVINYL CHLORIDE	0	2.2
		STRONTIUM PEROXIDE	0	1.7
1305-A365	14.5MM TRAINER M181 3 SEC DELAY	ALUMINUM POWDER	0.000006	0.83
		BARIUM NITRATE	0.000033	4.8
		ANTIMONY SULFIDE	0.000009	1.25
		LEAD STYPHNATE	0.000033	4.8
		NITROCELLULOSE	0.000416	60.82
		TETRACENE	0.000003	0.42
		NITROGLYCERIN	0.000186	27.19
1305-A400	CAL .38 SPEC BALL M41 130 GRAIN	DINITROTOLUENE	0.000027	2.66
		ETHYL CENTRALITE	0.000009	0.84
		DIPHENYLAMINE	0.000009	0.84
		NITROCELLULOSE	0.000683	66.96
		POTASSIUM SULFATE	0.000011	1.12
		NITROGLYCERIN	0.000229	22.45
		CALCIUM SILICIDE	0.000004	0.42
		ANTIMONY SULFIDE	0.000004	0.42
		LEAD STYPHNATE	0.000019	1.82
		BARIUM NITRATE	0.000021	2.1
1305-A404	CAL .38 SPEC WADCUTTER	BARIUM NITRATE	0.000021	2.71

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A404	CAL .38 SPEC WADCUTTER	NITROGLYCERIN	0.000294	37.26
		LEAD STYPHNATE	0.000019	2.36
		ETHYL CENTRALITE	0.000011	1.44
		NITROCELLULOSE	0.000429	54.37
		GRAPHITE	0.000004	0.54
		ANTIMONY SULFIDE	0.000004	0.54
		CALCIUM SILICIDE	0.000004	0.54
		TETRACENE	0.000001	0.18
1305-A475	CAL .45 BALL M1911	BARIUM NITRATE	0.000031	3.74
		NITROCELLULOSE	0.000576	68.65
		ETHYL CENTRALITE	0.000011	1.36
		NITROGLYCERIN	0.000154	18.36
		POTASSIUM SULFATE	0.000013	1.54
		POTASSIUM NITRATE	0.000013	1.54
		LEAD STYPHNATE	0.000027	3.23
		CALCIUM SILICIDE	0.000006	0.68
		ANTIMONY SULFIDE	0.000006	0.68
		TETRACENE	0.000001	0.17
1305-A555	CAL .50 BALL M2 M33 LNKD	DIPHENYLAMINE	0.0005	1.33
		DINITROTOLUENE	0.000343	0.91

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A555	CAL .50 BALL M2/M33 LNKD	DIBUTYLPHTHALATE	0.00336	8.96
		NITROCELLULOSE	0.0286	76.27
		NITROGLYCERIN	0.0037	9.87
		POTASSIUM NITRATE	0.000171	0.46
		CALCIUM CARBONATE	0.000343	0.91
		LEAD STYPHNATE	0.000124	0.33
		BARIUM NITRATE	0.000141	0.38
		SODIUM SULFATE	0.000171	0.46
1305-A572	CAL .50 TR M17 LNKD	DIPHENYLAMINE	0.000414	0.95
		DINITROTOLUENE	0.00321	7.36
		BARIUM	0.00146	4.87
		NITROCELLULOSE	0.0299	68.58
		STRONTIUM	0.00437	10.02
		POTASSIUM SULFATE	0.000329	0.75
		CHLORINATED RUBBER	0.000343	0.79
		CALCIUM RESINATE	0.000179	0.41
		MAGNESIUM POWDER	0.00229	5.25
		POLYVINYL CHLORIDE	0.000914	2.1
1305-A585	CAL .50 API-T M20 LNKD	BARIUM	0.00136	3.5
		DINITROTOLUENE	0.00329	8.56

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A585	CAL .50 API-T M20 LNKD	DIPHENYLAMINE	0.000429	1.1
		NITROCELLULOSE	0.0305	78.41
		LEAD STYPHNATE	0.000124	0.32
		POTASSIUM	0.000479	1.23
		CALCIUM RESINATE	0.000119	0.31
		STRONTIUM	0.000929	2.39
		MAGNESIUM/ALUMINUM ALLOY	0.00107	2.75
		MAGNESIUM POWDER	0.000446	1.15
1305-A652	20MM TP-T M220 SERIES LNKD	DIPHENYLAMINE	0	1.32
		DINITROTOLUENE	0	0.88
		DIBUTYLPHTHALATE	0	7.46
		NITROCELLULOSE	0	75.5
		POTASSIUM NITRATE	0	1.32
		TIN DIOXIDE	0	1.32
		BARIUM NITRATE	0	0.19
		LEAD STYPHNATE	0	0.18
		NITROGLYCERIN	0	9.66
		STRONTIUM NITRATE	0	1.43
1305-A655	20MM 7 HEI M56 SERIES/1 TP-T M220 LNKD	ALUMINUM POWDER	0	5.58
		DIBUTYLPHTHALATE	0	6.18

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A655	20MM 7 HEI M56 SERIES/1 TP-T M220 LNKD	NITROCELLULOSE	0	62.5
		NITROGLYCERIN	0	8
		RDX	0	9.94
		POTASSIUM PERCHLORATE	0	1.64
		DIPHENYLAMINE	0	1.1
		MAGNESIUM/ALUMINUM ALLOY	0	1.5
		TIN DIOXIDE	0	1.1
		POTASSIUM NITRATE	0	1.1
1305-A659	20MM HEI-T M242A1 SNGL RD	ALUMINUM POWDER	0.0071	5.59
		DIBUTYLPHTHALATE	0.00729	5.74
		NITROCELLULOSE	0.0737	58.03
		NITROGLYCERIN	0.00943	7.43
		STRONTIUM NITRATE	0.00176	1.39
		RDX	0.0135	10.63
		DIPHENYLAMINE	0.00129	1.02
		POTASSIUM NITRATE	0.00275	2.17
		MAGNESIUM/ALUMINUM ALLOY	0.00134	1.06
		TIN DIOXIDE	0.00129	1.02
1305-A662	20MM HEI M56 SERIES LNKD	DIBUTYLPHTHALATE	0.00729	5.83
		ALUMINUM POWDER	0.0075	6

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A662	20MM HEI M56 SERIES LNKD	NITROGLYCERIN	0.0943	7.54
		NITROCELLULOSE	0.0737	58.96
		POTASSIUM NITRATE	0.00348	2.78
		RDX	0.0142	11.36
		DIPHENYLAMINE	0.00129	1.03
		BARIUM NITRATE	0.000184	0.15
		MAGNESIUM/ALUMINUM ALLOY	0.00201	1.61
		TIN DIOXIDE	0.00129	1.03
1305-A701	20MM HEI M56A3 SERIES LNKD	DIPHENYLAMINE	0.000986	1.12
		GRAPHITE	0.00018	0.2
		HMX	0.00084	0.95
		NITROGLYCERIN	0.00814	9.23
		TIN DIOXIDE	0.000943	1.07
		RDX	0.000903	1.02
		LEAD STYPHNATE	0.000387	0.44
		CALCIUM	0.000509	0.58
		NITROCELLULOSE	0.0686	77.78
		POTASSIUM NITRATE	0.000686	0.78
1305-A775	20MM HEI M97 SNGL RD	DIBUTYLPHTHALATE	0.00679	6.01
		DINITROTOLUENE	0.00679	6.01

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A775	20MM HEI M97 SNGL RD	NITROCELLULOSE	0.0668	59.12
		NITROGLYCERIN	0.00786	6.96
		RDX	0.00115	10.18
		POTASSIUM NITRATE	0.00178	1.58
		LEAD STYPHNATE	0.000587	0.34
		ALUMINUM POWDER	0.006	5.31
		BARIUM NITRATE	0.000184	0.16
		TIN	0.000714	0.63
1305-A776	20MM INC M96 SNGL RD	CALCIUM RESINATE	0.000023	0.03
		DIPHENYLAMINE	0.00047	0.52
		DINITROTOLUENE	0.00497	5.49
		NITROCELLULOSE	0.0607	67.07
		MAGNESIUM/ALUMINUM ALLOY	0.0109	12.04
		POTASSIUM	0.0128	14.18
		LEAD THIOCYANATE	0.000076	0.08
		ANTIMONY SULFIDE	0.000036	0.04
		TIN	0.00047	0.53
		PETN	0.00003	0.03
1305-A785	20MM HEI M210 SNGL RD	DIBUTYLPHTHALATE	0.00686	6.41
		GRAPHITE	0.00443	4.14

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A785	20MM HEI M210 SNGL RD	NITROCELLULOSE	0.0613	57.29
		NITROGLYCERIN	0.00794	7.42
		POTASSIUM PERCHLORATE	0.00351	3.28
		RDX	0.00976	9.12
		DIPHENYLAMINE	0.00109	1.02
		MAGNESIUM/ALUMINUM ALLOY	0.00221	2.07
		ALUMINUM POWDER	0.00502	4.69
		TIN DIOXIDE	0.00109	1.02
1305-A792	20MM HEI-T-SD M246 SERIES LNKD RHF	DIBUTYLPHTHALATE	0	6.25
		ALUMINUM POWDER	0	5.01
		NITROGLYCERIN	0	8.09
		NITROCELLULOSE	0	63.27
		STRONTIUM NITRATE	0	1.78
		RDX	0	9.6
		DIPHENYLAMINE	0	1.11
		MAGNESIUM POWDER	0	1.01
		POTASSIUM NITRATE	0	1.11
		TIN DIOXIDE	0	1.11
1305-A806	20MM API MK107 MODS SNGL RD	DIPHENYLAMINE	0.00104	0.9
		DINITROTOLUENE	0.00809	7

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A806	20MM API MK107 MODS SNGL RD	NITROCELLULOSE	0.106	91.4
		GRAPHITE	0.000231	0.2
		POTASSIUM SULFATE	0.000694	0.6
1305-A809	20MM HPT T131 SNGL RD	DINITROTOLUENE	0.006	7
		DIPHENYLAMINE	0.000771	0.9
		NITROCELLULOSE	0.0783	91.4
		GRAPHITE	0.000171	0.2
		POTASSIUM SULFATE	0.000514	0.6
1305-A811	20MM TP MK105 SNGL RD	DINITROTOLUENE	0.00653	7
		DIPHENYLAMINE	0.00084	0.9
		NITROCELLULOSE	0.0853	91.4
		GRAPHITE	0.000187	0.2
		POTASSIUM SULFATE	0.00056	0.6
1305-A812	20MM AP-T MK108 SNGL RD	DINITROTOLUENE	0.00742	7
		DIPHENYLAMINE	0.000954	0.9
		NITROCELLULOSE	0.0969	91.4
		GRAPHITE	0.000212	0.2
		POTASSIUM SULFATE	0.000636	0.6
1305-A872	20MM API MK107 MOD 1 SNGL RD	DIPHENYLAMINE	0.00117	0.9
		DINITROTOLUENE	0.00907	7

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A872	20MM API MK107 MOD 1 SNGL RD	NITROCELLULOSE	0.119	91.4
		GRAPHITE	0.000259	0.2
		POTASSIUM SULFATE	0.000778	0.6
1305-A873	20MM AP-T MK108 MOD 1 SNGL RD	DINITROTOLUENE	0.00742	7
		DIPHENYLAMINE	0.000954	0.9
		GRAPHITE	0.000212	0.2
		NITROCELLULOSE	0.0969	91.4
		POTASSIUM SULFATE	0.000636	0.6
1305-A874	20MM TP MK105 MOD 1 SNGL RD	DINITROTOLUENE	0.00653	7
		DIPHENYLAMINE	0.00084	0.9
		GRAPHITE	0.000187	0.2
		NITROCELLULOSE	0.0853	91.4
		POTASSIUM SULFATE	0.00056	0.6
1305-A876	20MM TP MK105 MOD 0 SNGL RD	DIPHENYLAMINE	0.00084	0.9
		DINITROTOLUENE	0.00653	7
		GRAPHITE	0.000187	0.2
		NITROCELLULOSE	0.0853	91.4
		POTASSIUM SULFATE	0.00056	0.6
1305-A884	20MM API M53 LNKD	DIBUTYLPHTHALATE	0.00824	7.56
		DINITROTOLUENE	0.00087	0.8

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A884	20MM API M53 LNKD	BARIUM NITRATE	0.00193	1.77
		NITROCELLULOSE	0.0737	67.6
		NITROGLYCERIN	0.00954	8.75
		POTASSIUM PERCHLORATE	0.00234	2.15
		DIPHENYLAMINE	0.0013	1.19
		ALUMINUM NITRATE	0.00182	1.67
		MAGNESIUM/ALUMINUM ALLOY	0.00579	5.31
		TIN DIOXIDE	0.0013	1.19
1305-A890	20MM HEI M56 SERIES SNGL RD	DIBUTYLPHTHALATE	0.00729	6.03
		ALUMINUM POWDER	0.0075	6.21
		NITROCELLULOSE	0.0737	61.06
		NITROGLYCERIN	0.00943	7.81
		POTASSIUM NITRATE	0.00348	2.88
		RDX	0.0142	11.76
		LEAD STYPHNATE	0.000387	0.32
		MAGNESIUM/ALUMINUM ALLOY	0.00201	1.68
		DIPHENYLAMINE	0.00129	1.06
		TIN DIOXIDE	0.00129	1.06
1305-A892	20MM HPT M54A1 SNGL RD	DINITROTOLUENE	0.00602	7
		DIPHENYLAMINE	0.000774	0.9

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A892	20MM HPT M54A1 SNGL RD	NITROCELLULOSE	0.0786	91.4
		GRAPHITE	0.000172	0.2
		POTASSIUM SULFATE	0.000516	0.6
1305-A899	20MM FIRING CIRCUIT TEST MK109 MOD 0	DINITROTOLUENE	0.00653	7
		DIBUTYLAMINE	0.00084	0.9
		GRAPHITE	0.000187	0.2
		NITROCELLULOSE	0.0853	91.4
		POTASSIUM SULFATE	0.00056	0.6
1305-A974	25MM APDS-T M791 LNKD	DINITROTOLUENE	0.0154	7
		DIPHENYLAMINE	0.00198	0.9
		NITROCELLULOSE	0.202	91.4
		GRAPHITE	0.000441	0.2
		POTASSIUM SULFATE	0.00132	0.6
1305-A975	25MM HEI-T M792 LNKD	DIPHENYLAMINE	0.00187	0.71
		DINITROTOLUENE	0.0145	5.52
		NITROCELLULOSE	0.19	72.3
		HMX	0.052	19.79
		NYLON	0.00274	1.04
		POTASSIUM SULFATE	0.00125	0.48
		GRAPHITE	0.000416	0.16

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-A976	25MM TP-T M793 LNKD	DIPHENYLAMINE	0.00198	0.9
		DINITROTOLUENE	0.0154	7
		NITROCELLULOSE	0.202	91.4
		GRAPHITE	0.000441	0.2
		POTASSIUM SULFATE	0.00132	0.6
1305-A978	25MM TP PGU-23/U SNGL RD	DIPHENYLAMINE	0.00189	0.9
		DINITROTOLUENE	0.0147	7
		NITROCELLULOSE	0.191	91.4
		GRAPHITE	0.000419	0.2
		POTASSIUM SULFATE	0.00126	0.6
1305-B112	30MM HEI MK3Z LNKD LHF	PETN	0.11235	50
		TRINITROTOLUENE	0.11235	50
1305-B113	30MM TP MK4Z LNKD LHF	DINITROTOLUENE	0.0071	7
		DIPHENYLAMINE	0.0009	0.9
		NITROCELLULOSE	0.0925	91.4
		GRAPHITE	0.0002	0.2
		POTASSIUM SULFATE	0.0006	0.6
1305-B114	30MM HEI M3Z-1 LNKD RHF	PETN	0.1443	50
		TRINITROTOLUENE	0.1443	50
1305-B115	30MM TP MK4Z LNKD RHF	DIPHENYLAMINE	0.000912	0.9

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-B115	30MM TP MK4Z LNKD RHF	DINITROTOLUENE	0.0071	7
		NITROCELLULOSE	0.0925	91.4
		GRAPHITE	0.000203	0.2
		POTASSIUM SULFATE	0.000608	0.6
1305-B119	30MM TP M788 LNKD LHF	BARIUM NITRATE	0.000184	0.15
		DIPHENYLAMINE	0.00165	1.36
		LEAD STYPHNATE	0.00017	0.14
		NITROCELLULOSE	0.0937	77.11
		GRAPHITE	0.00044	0.36
		NITROGLYCERIN	0.0121	9.95
		CALCIUM CARBONATE	0.0011	0.9
		DIBUTYLPHTHALATE	0.011	9.05
		SODIUM SULFATE	0.00055	0.45
		POTASSIUM NITRATE	0.00055	0.45
1305-B120	30MM TP M788 LNKD RHF	BARIUM NITRATE	0.000184	0.15
		DIPHENYLAMINE	0.00165	1.36
		GRAPHITE	0.00044	0.36
		NITROCELLULOSE	0.0937	77.11
		LEAD STYPHNATE	0.00017	0.14
		NITROGLYCERIN	0.0121	9.95

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1305-B120	30MM TP M788 LNKD RHF	CALCIUM CARBONATE	0.0011	0.9
		DIBUTYLPHTHALATE	0.011	9.05
		SODIUM SULFATE	0.00055	0.45
		POTASSIUM NITRATE	0.00055	0.45
1305-B124	30MM HEI M799 LNKD LHF	PETN	0.1025	50
		TRINITROTOLUENE	0.1025	50
1305-B125	30MM HEI M799 LNKD RHF	PETN	0.1025	50
		TRINITROTOLUENE	0.1025	50
1310-B470	40MM HE M384 SERIES LNKD	LEAD	0.000149	0.11
		NITROGLYCERIN	0.00199	1.53
		NITROCELLULOSE	0.00792	6.08
		POTASSIUM NITRATE	0.000081	0.06
		RDX	0.118	90.63
		WAX	0.0018	1.38
		BARIUM NITRATE	0.00015	0.12
		ANTIMONY SULFIDE	0.000013	0.01
		ETHYL CENTRALITE	0.000061	0.05
		POTASSIUM CHLORATE	0.000027	0.02
1310-B475	40MM YLW SMK CANOPY M676	CHARCOAL	0.000413	0.31
		NITROGLYCERIN	0.00029	0.22

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B475	40MM YLW SMK CANOPY M676	NITROCELLULOSE	0.00042	0.31
		POTASSIUM NITRATE	0.00197	1.48
		POTASSIUM CHLORATE	0.0338	25.35
		SULFUR	0.000274	0.21
		LEAD	0.000016	0.01
		ANTIMONY SULFIDE	0.000009	0.01
		YELLOW DYE	0.0727	54.56
		VINYL ALCOHOL ACETATE RESIN	0.0026	1.95
1310-B480	40MM TP M385 SERIES LNKD F/HELI LAUNCHER	ANTIMONY SULFIDE	0.000009	0
		BARIUM NITRATE	0.000137	1.39
		ETHYL CENTRALITE	0.000059	0.6
		NITROCELLULOSE	0.0076	77.27
		NITROGLYCERIN	0.00191	19.46
		POTASSIUM NITRATE	0.000074	0.76
		LEAD THIOCYANATE	0.000013	0.13
		LEAD AZIDE	0.000003	0.03
		POTASSIUM CHLORATE	0.000027	0.28
1310-B506	40MM RED SMK M713	NITROGLYCERIN	0.000291	0.17
		NITROCELLULOSE	0.014	8.14
		1-N-METHLAMINO-ANTHRAQUINONE	0.0724	42.12

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B506	40MM RED SMK M713	POTASSIUM NITRATE	0.00038	0.22
		SODIUM BICARBONATE	0.00895	5.21
		POTASSIUM CHLORATE	0.0436	25.36
		CHROMIC OXIDE	0.00157	0.91
		BARIUM CHROMATE	0.00236	1.37
		BORON POWDER	0.000946	0.55
		POTASSIUM PERCHLORATE	0.000329	0.19
1310-B508	40MM GRN SMK M715	BORON POWDER	0.000946	0.55
		BARIUM CHROMATE	0.00236	1.37
		CHROMIC OXIDE	0.00157	0.91
		NITROCELLULOSE	0.000421	0.25
		POTASSIUM NITRATE	0.00038	0.22
		POTASSIUM CHLORATE	0.0406	23.63
		1,4-DI-P-TOLUIDINOANTHRAQUINON	0.0488	28.42
		MAGNESIUM CARBONATE	0.0282	16.38
		2-(2'-QUINOLYL)-1,3-INDANDIONE	0.0207	12.05
		POTASSIUM PERCHLORATE	0.000329	0.19
1310-B509	40MM YLW SMK M716	BORON POWDER	0.000946	0.55
		CHROMIC ACID	0.00157	0.91
		2-(2'-QUINOLYL)-1,3-INDANDIONE	0.0696	40.41

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B509	40MM YLW SMK M716	BARIUM CHROMATE	0.0236	1.37
		MAGNESIUM CARBONATE	0.0348	20.22
		POTASSIUM CHLORATE	0.0365	21.19
		POTASSIUM PERCHLORATE	0.000329	0.19
		POTASSIUM NITRATE	0.00038	0.22
		NITROCELLULOSE	0.000421	0.24
		NITROGLYCERIN	0.000291	0.17
1310-B519	40MM TP M781	ETHYL CENTRALITE	0.000006	0.08
		NITROCELLULOSE	0.000434	57.77
		NITROGLYCERIN	0.0003	39.93
		POTASSIUM NITRATE	0.000011	1.5
1310-B534	40MM MP M576	ANTIMONY SULFIDE	0.000009	0.02
		BARIUM NITRATE	0.000006	0.01
		NITROCELLULOSE	0.000321	0.6
		METAL PELLETS	0.0528	99.12
		NITROGLYCERIN	0.000081	0.15
		POTASSIUM NITRATE	0.000003	0.01
		ETHYL CENTRALITE	0.000003	0.01
		LEAD AZIDE	0.000003	0.01
		LEAD THIOCYANATE	0.000013	0.02

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B534	40MM MP M576	POTASSIUM CHLORATE	0.000027	0.05
1310-B535	40MM ILLUM WHT STAR PARA M583	BARIUM NITRATE	0.0859	41.3
		ALUMINUM POWDER	0.0286	13.75
		FUEL OIL #6	0.01634	7.86
		LEAD	0.000016	0
		MAGNESIUM POWDER	0.0512	24.62
		STRONTIUM NITRATE	0.0225	10.82
		ANTIMONY SULFIDE	0.000009	0
		NITROCELLULOSE	0.000421	0.2
		POTASSIUM NITRATE	0.00197	0.95
		NITROGLYCERIN	0.000291	0.14
1310-B536	40MM ILLUM WHT STAR CLSTR M585	BARIUM NITRATE	0.0785	41.21
		ASPHALTOM	0.00935	4.91
		ALUMINUM POWDER	0.0262	13.75
		MAGNESIUM POWDER	0.0468	24.57
		LINSEED OIL	0.00561	2.95
		STRONTIUM NITRATE	0.0206	10.81
		LEAD AZIDE	0.000016	0
		ANTIMONY SULFIDE	0.000009	0
		POTASSIUM NITRATE	0.00197	1.03

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B536	40MM ILLUM WHT STAR CLSTR M585	NITROCELLULOSE	0.000421	0.22
1310-B537	40MM CHEM AGENT CS M674	CHARCOAL	0.000194	0.09
		NITROCELLULOSE	0.0063	2.99
		POTASSIUM CHLORATE	0.0567	26.9
		POTASSIUM NITRATE	0.00092	0.44
		SUGAR	0.0378	17.93
		SULFUR	0.000129	0.06
		MAGNESIUM CARBONATE	0.0252	11.96
		O-CHLOROBENZALDAHYDE	0.0827	39.23
		MALONONITRATE	0.00084	0.4
1310-B538	40MM RED SMK M675	CHARCOAL	0.000194	0.06
		NITROCELLULOSE	0.0042	1.33
		SODIUM BICARBONATE	0.0348	11.04
		SULFUR	0.0261	8.28
		POTASSIUM NITRATE	0.00092	0.29
		POTASSIUM CHLORATE	0.0673	21.34
		DEXTRIN	0.116	36.79
		1-N-METHLAMINO-ANTHRAQUINONE	0.0658	20.87
1310-B542	40MM HEDP M430 LNKD	BARIUM NITRATE	0.00015	0.16
		NITROGLYCERIN	0.00199	2.09

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B542	40MM HEDP M430 LNKD	NITROCELLULOSE	0.00792	8.29
		LEAD	0.000268	0.28
		RDX	0.0824	86.34
		POTASSIUM NITRATE	0.000082	0.08
		DESENSITIZER	0.00125	1.31
		ETHYL CENTRALITE	0.000061	0.06
		TETRYL	0.00123	1.3
		POTASSIUM CHLORATE	0.000027	0.03
1310-B545	40MM BLANK SALUTING	CHARCOAL	0.116	15
		SULFUR	0.0771	10
		SODIUM NITRATE	0.578	75
1310-B546	40MM HEDP M433 (PA120 MTL CNTR)	DESENSITIZER	0.00149	1.49
		ANTIMONY SULFIDE	0.000013	0.01
		NITROGLYCERIN	0.000291	0.29
		LEAD	0.000149	0.14
		NITROCELLULOSE	0.000421	0.42
		RDX	0.097	97.58
		ETHYL CENTRALITE	0.000006	0.01
		BARIUM NITRATE	0.000007	0.01
		POTASSIUM NITRATE	0.000011	0.01

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B546	40MM HEDP M433 (PA120 MTL CNTR)	POTASSIUM CHLORIDE	0.000027	0.03
1310-B551	40MM AP M81A1 CLIPPED	DINITROTOLUENE	0.0649	9.44
		DIBUTYLPHTHALATE	0.0352	4.72
		DIPHENYLAMINE	0.00649	0.94
		NITROCELLULOSE	0.552	80.23
		STRONTIUM NITRATE	0.0112	1.62
		POTASSIUM	0.00685	0.99
		ALUMINUM	0.00038	0.05
		BARIUM PEROXIDE	0.0023	0.33
		MAGNESIUM	0.0075	1.09
		POLYVINYL CHLORIDE	0.0014	0.2
1310-B553	40MM HEP MK2	DIBUTYLPHTHALATE	0.036	4.11
		DINITROTOLUENE	0.0719	8.21
		DIPHENYLAMINE	0.00719	0.82
		NITROCELLULOSE	0.611	69.77
		POTASSIUM NITRATE	0.00686	0.78
		LEAD AZIDE	0.000291	0.03
		TRINITROTOLUENE	0.14	15.99
		ANTIMONY SULFIDE	0.000046	0.01
		CHARCOAL	0.00143	0.16

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B553	40MM HEP MK2	SULFUR	0.000951	0.11
1310-B555	40MM HEI-P MK2	DIBUTYLPHTHALATE	0.036	4.11
		DINITROTOLUENE	0.0719	8.21
		DIPHENYLAMINE	0.00719	0.82
		NITROCELLULOSE	0.611	69.77
		POTASSIUM NITRATE	0.00686	0.78
		ANTIMONY SULFIDE	0.000046	0.01
		TRINITROTOLUENE	0.14	15.99
		CHARCOAL	0.00143	0.16
		LEAD AZIDE	0.000291	0.03
		SULFUR	0.000951	0.11
1310-B556	40MM HEI-P-NP	TRINITROTOLUENE	0.203	100
1310-B557	40MM HEI-SD 4/CLIP	TRINITROTOLUENE	0.203	100
1310-B558	40MM HEI-T-NSD 4/CLIP	TRINITROTOLUENE	0.203	10
1310-B559	40MM HEI-T-SD 4/CLIP	DIPHENYLAMINE	0.0288	0.83
		DINITROTOLUENE	0.288	8.28
		DIBUTYLPHTHALATE	0.115	3.31
		NITROCELLULOSE	2.45	70.38
		POTASSIUM NITRATE	0.0274	0.79
		POTASSIUM CHLORATE	0.000398	0.01

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B559	40MM HEI-T-SD 4/CLIP	LEAD AZIDE	0.00105	0.03
		CHARCOAL	0.00548	0.16
		SULFUR	0.00366	0.11
		TRINITROTOLUENE	0.56	16.1
1310-B560	40MM HEI-T-DI-SD	TRINITROTOLUENE	0.203	100
1310-B561	40MM HE-P	TRINITROTOLUENE	0.203	100
1310-B562	40MM HE-T-SD MK2	TRINITROTOLUENE	0.203	100
1310-B563	40MM BL-P	DINITROTOLUENE	0.0462	7
		DIPHENYLAMINE	0.00595	0.9
		GRAPHITE	0.00132	0.2
		NITROCELLULOSE	0.604	91.4
		POTASSIUM SULFATE	0.00396	0.6
1310-B564	40MM BL-T 4/CLIP	DINITROTOLUENE	0.0462	7
		DIPHENYLAMINE	0.00595	0.9
		GRAPHITE	0.00132	0.2
		NITROCELLULOSE	0.604	91.4
		POTASSIUM SULFATE	0.00396	0.6
1310-B568	40MM HE M406	ANTIMONY SULFIDE	0.000013	0.02
		BARIUM NITRATE	0.000007	0.01
		LEAD	0.000149	0.2

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B568	40MM HE M406	RDX	0.0423	59.22
		TRINITROTOLUENE	0.0275	38.5
		WAX	0.000704	0.99
		ETHYL CENTRALITE	0.000006	0.01
		NITROCELLULOSE	0.000421	0.59
		POTASSIUM	0.000039	0.06
		NITROGLYCERIN	0.000291	0.41
1310-B569		ANTIMONY SULFIDE	0.000013	0.02
		BARIUM NITRATE	0.000007	0.01
		NITROCELLULOSE	0.000421	0.59
		NITROGLYCERIN	0.000291	0.41
		LEAD	0.000149	0.21
		POTASSIUM	0.000039	0.05
		ETHYL CENTRALITE	0.000006	0
		WAX	0.000704	0.99
		RDX	0.0423	59.32
		TRINITROTOLUENE	0.0275	38.52
1310-B571	40MM HE M383E1 LNKD	ANTIMONY SULFIDE	0.000013	0.01
		BARIUM NITRATE	0.00015	0.12
		DESENSITIZER	0.0018	1.38

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B571	40MM HE M383E1 LNKD	NITROCELLULOSE	0.00792	6.08
		NITROGLYCERIN	0.00199	1.53
		RDX	0.118	90.61
		GRAPHITE	0.00003	0.02
		ETHYL CENTRALITE	0.000061	0.05
		LEAD	0.000149	0.12
		POTASSIUM	0.000108	0.09
1310-B572	40MM HE M384 SERIES LNKD	DESENSITIZER	0.0018	1.38
		LEAD	0.000148	0.11
		NITROCELLULOSE	0.00792	6.06
		NITROGLYCERIN	0.00199	1.52
		POTASSIUM NITRATE	0.000081	0.06
		RDX	0.118	90.63
		BARIUM NITRATE	0.00015	0.11
		ANTIMONY SULFIDE	0.000013	0.01
		ETHYL CENTRALITE	0.000061	0.05
		POTASSIUM CHLORATE	0.000027	0.02
1310-B573	40MM HE M684 LNKD	BARIUM NITRATE	0.00015	0.12
		DESENSITIZER	0.00175	1.37
		NITROGLYCERIN	0.00199	1.56

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B573	40MM HE M684 LNKD	LEAD	0.000291	0.23
		NITROCELLULOSE	0.00792	6.21
		RDX	0.115	90.23
		ANTIMONY SULFIDE	0.000013	0.01
		ETHYL CENTRALITE	0.000061	0.05
		PETN	0.000131	0.1
		POTASSIUM NITRATE	0.000081	0.06
1310-B576	40MM TP M385 LNKD	BARIUM NITRATE	0.000137	1.39
		ANTIMONY SULFIDE	0.000009	0.09
		GRAPHITE	0.00003	0.3
		NITROCELLULOSE	0.0076	77.07
		NITROGLYCERIN	0.00119	19.37
		POTASSIUM NITRATE	0.000074	0.75
		LEAD THIOCYANATE	0.000013	0
		LEAD AZIDE	0.000003	0.03
		ETHYL CENTRALITE	0.000059	0.59
		POTASSIUM CHLORATE	0.000027	0.28
1310-B586	57MM HE M306A1	LEAD	0.000855	0.05
		NITROCELLULOSE	0.979	60.55
		TETRYL	0.0255	1.57

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B586	57MM HE M306A1	POTASSIUM	0.0402	2.52
		RDX	0.33	20.37
		ANTIMONY SULFIDE	0.000057	0
		DIPHENYLAMINE	0.00999	0.62
		BARIUM NITRATE	0.000219	0.01
		TRINITROTOLUENE	0.214	13.25
		CHARCOAL	0.00635	0.39
1310-B587	57MM HEAT M307 SERIES	NITROCELLULOSE	0.979	57.25
		LEAD	0.00064	0.04
		PETN	0.2	11.7
		RDX	0.245	14.33
		POTASSIUM	0.0405	2.37
		ANTIMONY SULFIDE	0.000169	0.01
		GRAPHITE	0.00999	0.58
		TRINITROTOLUENE	0.2	11.7
		DIPHENYLAMINE	0.00999	0.58
		TETRYL	0.015	0.88
1310-B588	57MM TP M306A1	BARIUM NITRATE	0.000219	0.02
		ANTIMONY SULFIDE	0.000057	0.01
		NITROCELLULOSE	0.979	86.17

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B588	57MM TP M306A1	LEAD AZIDE	0.000819	0.07
		POTASSIUM SULFATE	0.0909	8.01
		TETRYL	0.0255	2.24
		DIPHENYLAMINE	0.00999	0.88
		CHARCOAL	0.0171	1.5
		GRAPHITE	0.000999	0.09
		SULFUR	0.0114	1
1310-B590	57MM SMK WP M308A1	ANTIMONY SULFIDE	0.000057	0
		NITROCELLULOSE	0.979	67.52
		LEAD AZIDE	0.000819	0.06
		POTASSIUM SULFATE	0.0401	2.77
		TETRYL	0.0366	2.52
		GRAPHITE	0.000999	0.07
		BARIUM NITRATE	0.000219	0.02
		ALUMINUM POWDER	0.000023	0
		CALCIUM SILICIDE	0.000029	0
		WHITE PHOSPHOROUS	0.369	25.45
1310-B617	IGN M702 SERIES F/60MM MORTAR	DIPHENYLAMINE	0.000059	0.9
		DINITROCELLULOSE	0.000462	7
		GRAPHITE	0.000013	0.2

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B617	IGN M702 SERIES F/60MM MORTAR	NITROCELLULOSE	0.00603	91.4
		POTASSIUM SULFATE	0.000039	0.6
1310-B627	60MM ILLUM M83A3	ANTIMONY SULFIDE	0.00001	0
		CHARCOAL	0.00093	0.17
		LEAD THIOCYANATE	0.000036	0.01
		NITROCELLULOSE	0.00729	1.35
		LAMANIC	0.49	91.02
		POTASSIUM NITRATE	0.00441	0.82
		FIRST FIRE	0.035	6.5
		TRINITROTOLUENE	0.000006	0
		POTASSIUM CHLORATE	0.000051	0.01
		SULFUR	0.00062	0.12
1310-B630	60MM SMK WP M302 SERIES	ANTIMONY SULFIDE	0.000053	0.01
		CHARCOAL	0.000039	0
		LEAD AZIDE	0.000458	0.06
		TETRYL	0.026	3.35
		POTASSIUM CHLORATE	0.000253	0.03
		CARBORUNDUM	0.000007	0
		WHITE PHOSPHOROUS	0.75	96.53
		SULFUR	0.000026	0

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B630	60MM SMK WP M302 SERIES	NITROCELLULOSE	0.000002	0
		TRINITROTOLUENE	0.000003	0
1310-B632	60MM HE M49 SERIES	DESENSITIZER	0.00419	0.63
		NITROGLYCERIN	0.0134	2.02
		NITROCELLULOSE	0.0168	2.53
		TRINITROTOLUENE	0.34	51.36
		RDX	0.289	43.66
		TETRYL	0.000843	0.13
		LEAD AZIDE	0.000458	0.07
		ANTIMONY SULFIDE	0.000053	0.01
		DIETHYLPHTHALATE	0.000778	0.12
		POTASSIUM CHLORATE	0.000677	0.1
1310-B642	60MM HE XM720	DINITROTOLUENE	0.000462	0.1
		NITROCELLULOSE	0.0235	4.95
		RDX	0.282	59.38
		STEARIC ACID	0.000459	0.1
		GRAPHITE	0.000031	0.01
		TRINITROTOLUENE	0.164	34.48
		WAX	0.0042	0.88
		DIPHENYLAMINE	0.00023	0.05

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1310-B642	60MM HE XM720	POTASSIUM CHLORATE	0.000024	0.01
		POTASSIUM SULFATE	0.000219	0.05
1310-B643	60MM HE M888	RDX	0.517	60
		TRINITROTOLUENE	0.336	39
		WAX	0.00862	1
1310-B666	3 POUNDER BLNK MK1-1	CHARCOAL	0.15	15
		SULFUR	0.1	10
		POTASSIUM NITRATE	0.75	75
1310-C546	60-MM HIGH EXPLOSIVE CARTRIDGE XM720	DINITROTOLUENE	0.000462	0.1
		NITROCELLULOSE	0.0235	4.95
		STEARIC ACID	0.000459	0.1
		RDX	0.282	59.38
		WAX	0.0042	0.88
		TRINITROTOLUENE	0.164	34.48
		DIPHENYLAMINE	0.00023	0.05
		POTASSIUM SULFATE	0.000219	0.05
1315-C019	PROP F/81MM	DINITROCELLULOSE	0.01624	5.75
		NITROCELLULOSE	0.241	85.34
		ETHYL CENTRALITE	0.000377	0.13
		NITROGLYCERIN	0.0201	7.12

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C019	PROP F/81MM	POTASSIUM NITRATE	0.000754	0.27
		POTASSIUM SULFATE	0.001392	0.49
		DIPHENYLAMINE	0.002088	0.74
		GRAPHITE	0.000464	0.16
1315-C021	PROP INCREMENT A M90A1 F/81MM MORTAR	ETHYL CENTRALITE	0.000377	0.75
		NITROCELLULOSE	0.029	57.75
		NITROGLYCERIN	0.0201	40
		POTASSIUM NITRATE	0.000754	1.5
1315-C022	PROP INCREMENT B M90A1 F/81MM MORTAR	DINITROCELLULOSE	0.00203	7
		DIPHENYLAMINE	0.000261	0.9
		GRAPHITE	0.000058	0.2
		NITROCELLULOSE	0.0265	91.4
		POTASSIUM SULFATE	0.000174	0.6
1315-C025	75MM BLANK M337A2	CHARCOAL	0.15	15
		ANTIMONY SULFIDE	0.000024	0
		SULFUR	0.1	10
		POTASSIUM NITRATE	0.75	75
		POTASSIUM CHLORATE	0.000075	0.01
		LEAD THIOCYANATE	0.000036	0
		TRINITROTOLUENE	0.000007	0

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C027	75MM HE M48	DIBUTYLPHTHALATE	0.0529	1.78
		DINITROTOLUENE	0.106	3.56
		NITROCELLULOSE	0.9	30.2
		TRINITROTOLUENE	1.85	62.08
		POTASSIUM CHLORATE	0.00859	0.29
		TETRYL	0.0495	1.66
		CHARCOAL	0.00178	0.06
		ANTIMONY SULFIDE	0.000081	0
		DIPHENYLAMINE	0.0106	0.36
		LEAD	0.00123	0.04
1315-C032	75MM SMK WP M64	DIBUTYLPHTHALATE	0.0529	2.16
		DINITROTOLUENE	0.106	4.26
		DIPHENYLAMINE	0.0106	0.43
		NITROCELLULOSE	0.9	36.15
		TETRYL	0.0686	2.76
		LEAD	0.000732	0.03
		WHITE PHOSPHOROUS	1.34	52.82
		CHARCOAL	0.00223	0.09
		ANTIMONY SULFIDE	0.000081	0
		POTASSIUM CHLORATE	0.0107	0.43

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C051	75MM HE M309 SERIES	ANTIMONY SULFIDE	0.000086	0
		LEAD	0.00124	0.03
		NITROCELLULOSE	3.23	66.05
		TETRYL	0.0495	1.01
		POTASSIUM	0.0648	1.33
		DINITROTOLUENE	0.00595	0.12
		CHARCOAL	0.0669	0.14
		TRINITROTOLUENE	1.49	30.47
		DIPHENYLAMINE	0.033	0.68
		SULFUR	0.00446	0.09
1315-C052	75MM HEAT M310	NITROCELLULOSE	3.12	74.64
		LEAD THIOCYANATE	0.000397	0.01
		PETN	0.445	10.65
		POTASSIUM	0.0637	1.52
		TETRYL	0.0453	1.08
		ALUMINUM POWDER	0.000171	0
		TRINITROTOLUENE	0.445	10.65
		DIPHENYLAMINE	0.0319	0.76
		MAGNESIUM	0.00351	0.08
		STRONTIUM NITRATE	0.0056	0.13

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C053	75MM HEP-T M349	DESENSITIZER	0.229	3.81
		LEAD AZIDE	0.000397	0.01
		MAGNESIUM	0.00351	0.06
		NITROCELLULOSE	3.29	54.74
		POTASSIUM	0.0654	1.09
		RDX	2.32	38.6
		ALUMINUM POWDER	0.000171	0
		DIPHENYLAMINE	0.0336	0.56
		STRONTIUM NITRATE	0.0056	0.09
		TETRYL	0.0453	0.75
1315-C056	75MM SMK WP M311	ANTIMONY SULFIDE	0.000081	0
		LEAD	0.000732	0.02
		NITROCELLULOSE	3.35	68.65
		POTASSIUM	0.066	1.35
		TETRYL	0.063	1.29
		GRAPHITE	0.00342	0.07
		CHARCOAL	0.00669	0.14
		WHITE PHOSPHOROUS	1.35	27.66
		DIPHENYLAMINE	0.0342	0.7
		SULFUR	0.00446	0.09

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C057	75MM HE M309A1	DIPHENYLAMINE	0.033	0.67
		CHARCOAL	0.00669	0.14
		NITROCELLULOSE	3.23	66.13
		TETRYL	0.0495	1.01
		POTASSIUM	0.0648	1.33
		TRINITROTOLUENE	1.49	30.41
		GRAPHITE	0.0033	0.07
		DINITROTOLUENE	0.00595	0.12
		LEAD	0.00124	0.03
		SULFUR	0.00446	0.09
1315-C098	76MM TP-T M340A1	ETHYL CENTRALITE	0.084	1.48
		MAGNESIUM POWDER	0.0057	0.1
		NITROCELLULOSE	1.57	27.7
		NITROGLYCERIN	1.26	22.26
		STRONTIUM NITRATE	0.00533	0.09
		NITROGUANIDINE	2.67	47.17
		LEAD THIOCYANATE	0.000036	0
		CHARCOAL	0.00891	0.16
		BARIUM PEROXIDE	0.00301	0.05
		POTASSIUM NITRATE	0.0423	0.75

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C112	76MM HE IR MX165	DIPHENYLAMINE	0.0485	0.72
		DINITROTOLUENE	0.377	5.59
		NITROCELLULOSE	4.93	73.15
		RDX	1.23	18.25
		POTASSIUM SULFATE	0.0323	0.48
		WAX	0.122	1.81
		GRAPHITE	0.0108	0.16
1315-C113	76MM HE PD MX166	DIPHENYLAMINE	0.0485	0.72
		DINITROTOLUENE	0.377	5.59
		NITROCELLULOSE	4.93	73.15
		POTASSIUM SULFATE	0.0323	0.48
		RDX	1.23	18.25
		WAX	0.122	1.81
		GRAPHITE	0.0108	0.16
1315-C120	76MM AP-T M339	NITROGLYCERIN	1.26	22.3
		ETHYL CENTRALITE	0.08	1.42
		NITROCELLULOSE	1.57	27.79
		LEAD	0.000036	0
		NITROGUANIDINE	2.67	47.26
		STRONTIUM NITRATE	0.00533	0.09

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C120	76MM AP-T M339	BARIUM PEROXIDE	0.00301	0.05
		MAGNESIUM POWDER	0.0057	0.1
		PERCHLOROPENTACYCLODECANE	0.000843	0.01
		POTASSIUM	0.0424	0.75
1315-C122	76MM HE M352	DIPHENYLAMINE	0.04	0.7
		DINITROTOLUENE	0.36	6.92
		DIBUTYLPHTHALATE	0.07	1.35
		NITROCELLULOSE	3.17	60.96
		RDX	0.88	16.92
		LEAD	0.00123	0.02
		ANTIMONY SULFIDE	0.000081	0
		TRINITROTOLUENE	0.57	10.96
		POTASSIUM	0.0424	0.82
		TETRYL	0.0495	0.95
1315-C128	76MM SMK WP M361	DIBUTYLPHTHALATE	0.07	1.36
		DINITROTOLUENE	0.36	7
		DIPHENYLAMINE	0.04	0.7
		NITROCELLULOSE	3.17	61.55
		LEAD	0.000732	0.01
		ANTIMONY SULFIDE	0.000081	0

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C128	76MM SMK WP M361	BARIUM CHROMATE	0.00006	0
		WHITE PHOSPHOROUS	1.38	26.8
		POTASSIUM	0.0424	0.82
		TETRYL	0.075	1.45
1315-C136	3 IN 50 CAL VT MK33	DIPHENYLAMINE	0.036	0.72
		DINITROTOLUENE	0.28	5.6
		GRAPHITE	0.008	0.16
		NITROCELLULOSE	3.66	73.2
		HE	0.99	19.8
		POTASSIUM SULFATE	0.024	0.48
1315-C137		DIPHENYLAMINE	0.036	0.72
		DINITROTOLUENE	0.28	5.6
		NITROCELLULOSE	3.66	73.2
		GRAPHITE	0.008	0.16
		HE	0.99	19.8
		POTASSIUM SULFATE	0.024	0.48
1315-C143	3 IN 50 CAL AP MK29	DIPHENYLAMINE	0.036	0.87
		DINITROTOLUENE	0.28	6.75
		HE	0.14	3.37
		GRAPHITE	0.008	0.19

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C143	3 IN 50 CAL AP MK29	NITROCELLULOSE	3.66	88.19
		POTASSIUM SULFATE	0.024	0.58
1315-C150	3 IN 50 CAL VT NSD MK33	DINITROTOLUENE	0.28	5.6
		DIPHENYLAMINE	0.036	0.72
		HE	0.99	19.8
		GRAPHITE	0.008	0.16
		NITROCELLULOSE	3.66	73.2
		POTASSIUM SULFATE	0.024	0.48
1315-C152	3 IN 50 CAL VT SD MK33	DIPHENYLAMINE	0.036	0.72
		DINITROTOLUENE	0.28	5.6
		NITROCELLULOSE	3.66	73.2
		HE	0.99	19.8
		GRAPHITE	0.008	0.16
		POTASSIUM SULFATE	0.024	0.48
1315-C162	3 IN 50 CAL VT NON-FRAG MK33	DINITROTOLUENE	0.31	5.56
		DIPHENYLAMINE	0.0398	0.72
		NITROCELLULOSE	4.04	72.66
		GRAPHITE	0.00884	0.16
		POTASSIUM SULFATE	0.0265	0.48
		POTASSIUM NITRATE	0.855	15.35

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C162	3 IN 50 CAL VT NON-FRAG MK33	CHARCOAL	0.171	3.07
		SULFUR	0.114	2.05
1315-C164		DINITROTOLUENE	0.31	5.57
		DIPHENYLAMINE	0.0398	0.72
		NITROCELLULOSE	4.04	72.53
		GRAPHITE	0.00884	0.16
		POTASSIUM NITRATE	0.855	15.35
		POTASSIUM SULFATE	0.0265	0.48
		CHARCOAL	0.171	3.07
		SULFUR	0.114	2.05
1315-C172	3 IN 50 CAL ILLUM MK25 MODS	DINITROTOLUENE	0.333	6.07
		DIPHENYLAMINE	0.0428	0.78
		GRAPHITE	0.0095	0.17
		NITROCELLULOSE	4.34	79.05
		POTASSIUM SULFATE	0.0285	0.52
		POTASSIUM NITRATE	0.553	10.07
		CHARCOAL	0.111	2.02
		SULFUR	0.0738	1.34
1315-C178	3 IN 50 CAL BL-T MK27	DINITROTOLUENE	0.28	7
		DIPHENYLAMINE	0.036	0.9

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C178	3 IN 50 CAL BL-T MK27	GRAPHITE	0.008	0.2
		NITROCELLULOSE	3.66	91.4
		POTASSIUM SULFATE	0.024	0.6
1315-C179	3 IN 50 CAL BL-P MK27	DINITROTOLUENE	0.28	7
		DIPHENYLAMINE	0.036	0.9
		GRAPHITE	0.008	0.2
		NITROCELLULOSE	3.66	91.4
		POTASSIUM SULFATE	0.024	0.6
1315-C183	3 IN 50 CAL BLANK	CHARCOAL	0.301	15
		SULFUR	0.201	10
		SODIUM NITRATE	1.51	75
1315-C212	3 IN 50 CAL AP MK29	DIPHENYLAMINE	0.036	0.87
		DINITROTOLUENE	0.28	6.75
		AMMONIUM PICRATE	0.14	3.37
		GRAPHITE	0.008	0.19
		NITROCELLULOSE	3.66	88.19
		POTASSIUM SULFATE	0.024	0.58
1315-C215		DINITROTOLUENE	0.28	6.75
		DIPHENYLAMINE	0.036	0.87
		HE	0.14	3.37

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C215	3 IN 50 CAL AP MK29	GRAPHITE	0.008	0.19
		NITROCELLULOSE	3.66	88.19
		POTASSIUM SULFATE	0.024	0.58
1315-C218	3 IN 50 CAL HC MK27	DINITROTOLUENE	0.28	5.26
		DIPHENYLAMINE	0.036	0.68
		NITROCELLULOSE	3.66	68.8
		GRAPHITE	0.008	0.15
		RDX	1.19	22.37
		POTASSIUM SULFATE	0.024	0.45
		WAX	0.118	2.24
1315-C222	81MM HE M362 SERIES W/PD FUZE	DESENSITIZER	0.021	0.88
		BARIUM NITRATE	0.0026	0.11
		NITROGLYCERIN	0.0345	1.45
		NITROCELLULOSE	0.162	6.8
		RDX	1.34	56.19
		GRAPHITE	0.000556	0.02
		LEAD	0.00106	0.04
		ETHYL CENTRALITE	0.00125	0.05
		TRINITROTOLUENE	0.819	34.35
		POTASSIUM	0.0021	0.09

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C223	81MM HE M362 W/O FUZE	BARIUM NITRATE	0.00261	0.11
		DESENSITIZER	0.021	0.91
		NITROGLYCERIN	0.0345	1.5
		NITROCELLULOSE	0.162	7.04
		RDX	1.26	57.4
		TRINITROTOLUENE	0.82	35.6
		GRAPHITE	0.000056	0.02
		ETHYL CENTRALITE	0.00125	0.05
		LEAD THIOCYANATE	0.000013	0
		POTASSIUM	0.0021	0.09
1315-C225	81MM HE M43A1 W/PD FUZE M525	DIBUTYLPHTHALATE	0.0027	0.2
		NITROCELLULOSE	0.057	4
		NITROGLYCERIN	0.046	3.2
		RDX	0.81	56.5
		ETHYL CENTRALITE	0.000686	0.05
		WAX	0.01	0.9
		TRINITROTOLUENE	0.5	34.9
		DINITROTOLUENE	0.00206	0.14
		POTASSIUM NITRATE	0.00144	0.1
		TETRYL	0.000843	0.06

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C227	81MM TP M43A1 W/PD FUZE	CHARCOAL	0.00851	5.13
		DIBUTYLPHTHALATE	0.00273	0.88
		ETHYL CENTRALITE	0.000686	0.22
		NITROCELLULOSE	0.1416	45.4
		NITROGLYCERIN	0.0461	14.8
		POTASSIUM NITRATE	0.0418	25.2
		LEAD	0.000037	0.01
		BARIUM NITRATE	0.000027	0.01
		ANTIMONY SULFIDE	0.000013	0
		SULFUR	0.00567	3.5
1315-C230	81MM SMK WP M57/57A1 W/PD FUZE	LEAD	0.000475	0.01
		NITROGLYCERIN	0.00697	0.16
		NITROCELLULOSE	0.0101	0.24
		TETRYL	0.0808	1.92
		RDX	0.0372	0.89
		ANTIMONY SULFIDE	0.000056	0
		ETHYL CENTRALITE	0.00014	0
		WHITE PHOSPHOROUS	4.06	96.7
		BARIUM NITRATE	0.000271	0
		POTASSIUM	0.000304	0

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C236	81MM HE M374 SERIES W/O PD FUZE	DESENSITIZER	0.02	0.82
		NITROGLYCERIN	0.09	3.72
		NITROCELLULOSE	0.14	5.79
		RDX	1.34	55.44
		POTASSIUM NITRATE	0.00385	0.16
		ETHYL CENTRALITE	0.00188	0.08
		CHARCOAL	0.00007	0
		TRINITROTOLUENE	0.82	33.93
		LEAD	0.00105	0.04
		SULFUR	0.000046	0
1315-C242	IGN M6 F/81MM MORTAR	NITROGLYCERIN	0.00697	40
		ETHYL CENTRALITE	0.000131	0.75
		NITROCELLULOSE	0.0101	57.75
		POTASSIUM NITRATE	0.000261	1.5
1315-C256	81MM HE M374 SERIES W/PD FUZE	ANTIMONY SULFIDE	0.000038	0
		LEAD	0.00108	0
		NITROCELLULOSE	0.038	1.78
		NITROGLYCERIN	0.027	1.33
		RDX	1.34	59.56
		ETHYL CENTRALITE	0.0005	0

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C256	81MM HE M374 SERIES W/PD FUZE	TRINITROTOLUENE	0.82	36.44
		BARIUM	0.000064	0
		WAX	0.02	0.89
		POTASSIUM	0.00141	0
1315-C262	90MM CANISTER APER M336	BARIUM NITRATE	0.112	1.39
		ETHYL CENTRALITE	0.048	0.6
		GRAPHITE	0.0329	0.41
		NITROCELLULOSE	6.2	76.95
		NITROGLYCERIN	1.56	19.36
		POTASSIUM NITRATE	0.106	1.32
		SULFUR	0.00594	0.07
1315-C265	90MM HE M71 W/MTSQ FUZE M502	NITROGLYCERIN	1.3889	14.54
		ETHYL CENTRALITE	0.4386	4.59
		NITROCELLULOSE	1.462	15.3
		NITROGUANIDINE	3.9986	41.85
		RDX	1.29	13.5
		TRINITROTOLUENE	0.8385	8.78
		ANTIMONY SULFIDE	0.000069	0
		CRYOLITE	0.0219	0.23
		TETRYL	0.049616	0.52

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C265	90MM HE M71 W/MTSQ FUZE M502	POTASSIUM NITRATE	0.031714	0.33
1315-C266	90MM HE M71 W/PD FUZE	NITROGLYCERIN	1.39	14.65
		NITROCELLULOSE	1.46	15.38
		ETHYL CENTRALITE	0.44	4.64
		NITROGUANIDINE	4	42.15
		RDX	1.34	14.12
		ANTIMONY	0.000225	0
		LEAD	0.00136	0
		TRINITROTOLUENE	0.84	8.85
		CRYOLITE	0.02	0.21
		STRONTIUM	0.00341	0
1315-C267	90MM HE M71 W/O FUZE	NITROGLYCERIN	1.39	14.67
		ETHYL CENTRALITE	0.44	4.65
		NITROCELLULOSE	1.46	15.41
		RDX	1.29	13.62
		NITROGUANIDINE	4	42.23
		ANTIMONY SULFIDE	0.000024	0
		TRINITROTOLUENE	0.84	8.87
		CRYOLITE	0.02	0.21
		STRONTIUM	0.00341	0.04

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C267	90MM HE M71 W/O FUZE	POTASSIUM	0.032	0.31
1315-C275	90MM APER-T M580 SERIES	DIBUTYLPHTHALATE	0.18	1.99
		DIPHENYLAMINE	0.09	1
		DINITROTOLUENE	0.9	9.96
		ANTIMONY	0.000031	0
		NITROCELLULOSE	7.83	86.62
		POTASSIUM NITRATE	0.0424	0.44
		BARIUM	0.00302	0
		LEAD	0.000504	0
		STRONTIUM NITRATE	0.00533	0
		MAGNESIUM POWDER	0.0057	0
1315-C276	81MM SMK WP M375A3 W/PD FUZE 00-574-7680	ETHYL CENTRALITE	0.002	0.1
		NITROGLYCERIN	0.1	5.18
		NITROCELLULOSE	0.145	7.48
		SULFUR	0.000046	0
		POTASSIUM NITRATE	0.00408	0.21
		LEAD AZIDE	0.00101	0.05
		LEAD THIOCYANATE	0.000013	0
		WHITE PHOSPHOROUS	1.6	82.83
		POTASSIUM CHLORATE	0.000029	0

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C276	81MM SMK WP M375A3 W/PD FUZE 00-574-7680	RDX	0.0797	4.13
1315-C280	90MM, M71A1 2/P	DIBUTYLPHTHALATE	0	3.44
		DINITROTOLUENE	0	7.01
		NITROCELLULOSE	0	59.13
		POTASSIUM CHLORATE	0	0.42
		RDX	0	17.06
		BARIUM	0	0
		ANTIMONY SULFIDE	0	0
		TRINITROTOLUENE	0	11.1
		LEAD	0	0.02
		STRONTIUM	0	0.05
1315-C282	90MM HEAT M371A1	BARIUM NITRATE	0.0182	0.6
		NITROGLYCERIN	0.195	6.46
		NITROCELLULOSE	1.06	35.15
		RDX	1.032	34.22
		TRINITROTOLUENE	0.6708	22.24
		CHARCOAL	0.000178	0.01
		WAX	0.0172	0.57
		GRAPHITE	0.0039	0.13
		ETHYL CENTRALITE	0.00779	0.26

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C282	90MM HEAT M371A1	POTASSIUM NITRATE	0.0106	0.35
1315-C283	90MM PRAC M371	BARIUM NITRATE	0	1.4
		NITROCELLULOSE	1.5	82
		GRAPHITE	0	0.4
		ETHYL CENTRALITE	0	0.6
		NITROGLYCERIN	0	15
		POTASSIUM NITRATE	0	0.8
1315-C285	90MM AP-T M318 SERIES	DINITROTOLUENE	0.86	9.82
		DIPHENYLAMINE	0.09	1.03
		DIBUTYLPHTHALATE	0.17	1.94
		NITROCELLULOSE	7.48	85.42
		MAGNESIUM POWDER	0.03514	0.4
		STRONTIUM NITRATE	0.056	0.64
		ALUMINUM	0.00172	0.02
		CHARCOAL	0.00891	0.1
		LEAD THIOCYANATE	0.000036	0
		POTASSIUM NITRATE	0.0423	0.48
1315-C287	90MM HE-T M71A1	DINITROTOLUENE	0.533	7.02
		DIPHENYLAMINE	0.0533	0.7
		DIBUTYLPHTHALATE	0.2665	3.51

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C287	90MM HE-T M71A1	NITROCELLULOSE	4.5305	59.7
		RDX	1.29	16.99
		TRINITROTOLUENE	0.8385	11.05
		ANTIMONY SULFIDE	0.000081	0
		LEAD	0.00124	0.02
		TETRYL	0.04946	0.65
		WHITE PHOSPHOROUS	0.01464	0.19
1315-C290	90MM TP-T M353	NITROCELLULOSE	2.4	27.8
		GRAPHITE	0.009	0.1
		ETHYL CENTRALITE	0.13	1.5
		POTASSIUM NITRATE	0.042	0.49
		NITROGLYCERIN	1.9	22
		NITROGUANIDINE	4.1	47.4
		ANTIMONY SULFIDE	0.000024	0
		POTASSIUM CHLORATE	0.000076	0
		STRONTIUM NITRATE	0.0028	0.03
		MAGNESIUM POWDER	0.0018	0.03
1315-C296	3 IN 50 CAL HC MK27	DINITROTOLUENE	0.28	5.88
		DIPHENYLAMINE	0.036	0.76
		NITROCELLULOSE	3.66	76.97

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C296	3 IN 50 CAL HC MK27	GRAPHITE	0.008	0.17
		POTASSIUM SULFATE	0.024	0.5
		TRINITROTOLUENE	0.75	15.79
1315-C299	3 IN 50 CAL AA MK27 NON-FL	DIPHENYLAMINE	0.036	0.76
		DINITROTOLUENE	0.28	5.88
		GRAPHITE	0.008	0.17
		NITROCELLULOSE	3.66	76.97
		POTASSIUM SULFATE	0.024	0.5
		TRINITROTOLUENE	0.75	15.79
1315-C302	3 IN 50 CAL AA MK27 FLASHLESS	DIPHENYLAMINE	0.036	0.77
		DINITROTOLUENE	0.28	5.88
		GRAPHITE	0.00803	0.17
		NITROCELLULOSE	3.66	76.97
		POTASSIUM SULFATE	0.024	0.5
		TRINITROTOLUENE	0.75	15.79
1315-C305	3 IN 50 CAL ILLUM MK25	DINITROTOLUENE	0.333	6.07
		DIPHENYLAMINE	0.0428	0.78
		GRAPHITE	0.0095	0.17
		NITROCELLULOSE	4.34	79.05
		POTASSIUM SULFATE	0.0285	0.52

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C305	3 IN 50 CAL ILLUM MK25	POTASSIUM NITRATE	0.553	10.07
		CHARCOAL	0.111	2.02
		SULFUR	0.0738	1.34
1315-C306	3 IN 50 CAL HE-IR MK33	DIPHENYLAMINE	0.0449	0.74
		DINITROTOLUENE	0.349	5.79
		GRAPHITE	0.00998	0.17
		NITROCELLULOSE	4.56	75.56
		RDX	0.952	15.77
		POTASSIUM SULFATE	0.0299	0.5
		WAX	0.0941	1.56
1315-C307		DIPHENYLAMINE	0.036	0.72
		DINITROTOLUENE	0.28	5.61
		NITROCELLULOSE	3.66	73.27
		GRAPHITE	0.008	0.16
		POTASSIUM SULFATE	0.024	0.48
		TRINITROTOLUENE	0.99	19.84
1315-C319	3 IN 50 CAL VT NON-FRAG MK31	DIPHENYLAMINE	0.0398	0.72
		DINITROTOLUENE	0.31	5.57
		NITROCELLULOSE	4.04	72.53
		GRAPHITE	0.00884	0.16

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C319	3 IN 50 CAL VT NON-FRAG MK31	POTASSIUM SULFATE	0.0265	0.48
		POTASSIUM NITRATE	0.855	15.35
		CHARCOAL	0.171	3.07
		SULFUR	0.114	2.05
1315-C320		DINITROTOLUENE	0.31	5.57
		DIPHENYLAMINE	0.0398	0.72
		GRAPHITE	0.00884	0.16
		NITROCELLULOSE	4.04	72.53
		POTASSIUM NITRATE	0.855	15.35
		POTASSIUM SULFATE	0.0265	0.48
		CHARCOAL	0.171	3.07
		SULFUR	0.114	2.05
1315-C321	3 IN 50 CAL HE-IR MK31 NON-FL	DIPHENYLAMINE	0.0449	0.74
		DINITROTOLUENE	0.349	5.79
		NITROCELLULOSE	4.56	75.56
		GRAPHITE	0.00998	0.17
		RDX	0.952	15.77
		POTASSIUM SULFATE	0.0299	0.5
		WAX	0.0941	1.56
1315-C322	3 IN 50 CAL HE-IR MK31 FLASHLESS	DINITROTOLUENE	0.28	5.61

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C322	3 IN 50 CAL HE-IR MK31 FLASHLESS	DIPHENYLAMINE	0.036	0.72
		NITROCELLULOSE	3.66	73.27
		GRAPHITE	0.008	0.16
		POTASSIUM SULFATE	0.024	0.48
		TRINITROTOLUENE	0.99	19.84
1315-C338	3 IN 50 CAL BL-P MK29/27/189	DIPHENYLAMINE	0.036	0.9
		DINITROTOLUENE	0.28	7
		NITROCELLULOSE	3.66	91.4
		GRAPHITE	0.008	0.2
		POTASSIUM SULFATE	0.024	0.6
1315-C341	3 IN 50 CAL BL-P MK29/27/185 FLASHLESS	DIPHENYLAMINE	0.036	0.9
		DINITROTOLUENE	0.28	7
		NITROCELLULOSE	3.66	91.4
		GRAPHITE	0.008	0.2
		POTASSIUM SULFATE	0.024	0.6
1315-C347	3 IN 50 CAL HC MK33 FLASHLESS	DINITROTOLUENE	0.28	5.88
		DIPHENYLAMINE	0.036	0.76
		NITROCELLULOSE	3.66	76.97
		GRAPHITE	0.008	0.17
		POTASSIUM SULFATE	0.024	0.5

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C347	3 IN 50 CAL HC MK33 FLASHLESS	TRINITROTOLUENE	0.75	15.79
1315-C348	3 IN 50 CAL HC MK33 NON-FL	DINITROTOLUENE	0.28	5.26
		DIPHENYLAMINE	0.036	0.68
		NITROCELLULOSE	3.66	68.8
		GRAPHITE	0.008	0.15
		RDX	1.19	22.37
		POTASSIUM SULFATE	0.024	0.45
		WAX	0.119	2.24
1315-C373	3 IN 50 CAL VT NON-FRAG MK36 NFL	DIPHENYLAMINE	0.059	0.77
		DINITROTOLUENE	0.458	5.96
		GRAPHITE	0.0131	0.17
		NITROCELLULOSE	5.99	77.85
		POTASSIUM SULFATE	0.0393	0.51
		SODIUM NITRATE	0.855	11.12
		CHARCOAL	0.171	2.22
		SULFUR	0.114	1.48
1315-C375		DINITROTOLUENE	0.458	5.96
		DIPHENYLAMINE	0.059	0.77
		NITROCELLULOSE	5.99	77.85
		GRAPHITE	0.0131	0.17

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C375	3 IN 50 CAL VT NON-FRAG MK36 NFL	POTASSIUM SULFATE	0.0393	0.51
		SODIUM NITRATE	0.855	11.12
		CHARCOAL	0.171	2.22
		SULFUR	0.114	1.48
1315-C429	105MM HEP-T M393 SERIES	DIBUTYLPHTHALATE	0.295	2.38
		DINITROTOLUENE	0.59	4.76
		DIPHENYLAMINE	0.059	0.48
		NITROCELLULOSE	5.015	40.44
		RDX	5.824	46.96
		CHARCOAL	0.010096	0.08
		WAX	0.576	4.64
		POTASSIUM NITRATE	0.047889	0.39
		STRONTIUM NITRATE	0.014586	0.12
		MAGNESIUM POWDER	0.014643	0.12
1315-C430	105MM HE M1 W/O FUZE	DINITROTOLUENE	0.282	2.34
		LEAD THIOCYANATE	0.000036	0
		TRINITROTOLUENE	6.34	52.68
		RDX	2.76	22.93
		POTASSIUM NITRATE	0.0314	0.26
		POTASSIUM CHLORATE	0.000076	0

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C430	105MM HE M1 W/O FUZE	DIPHENYLAMINE	0.0282	0.23
		DIBUTYLPHTHALATE	0.14	1.16
		ANTIMONY SULFIDE	0.000024	0
		NITROCELLULOSE	2.4	19.93
1315-C432	105MM HE M1 W/PD FUZE M557	DIBUTYLPHTHALATE	1.41	10
		DINITROTOLUENE	0.33	2.36
		NITROCELLULOSE	2.4	17.03
		LEAD	0.00136	0.01
		RDX	3.09	21.93
		TRINITROTOLUENE	6.78	48.12
		DIPHENYLAMINE	0.0282	0.2
		TETRYL	0.00375	0.03
		POTASSIUM NITRATE	0.0317	0.23
1315-C436	PROP 105MM M7	CARBON BLACK	0.03	1.2
		ETHYL CENTRALITE	0.03	0.9
		NITROCELLULOSE	1.54	54.6
		NITROGLYCERIN	1	35.5
		POTASSIUM PERCHLORATE	0.22	7.8
1315-C440	105 MM BLANK M395	ANTIMONY SULFIDE	0.000049	0
		CHARCOAL	0.266	15

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C440	105 MM BLANK M395	LEAD	0.000071	0
		SULFUR	0.1766	9.9
		POTASSIUM NITRATE	1.33	75.1
		POTASSIUM CHLORIDE	0.000076	0
		TRINITROTOLUENE	0.000014	0
		POTASSIUM CHLORATE	0.000076	0
1315-C444	105 MM HE M1 W/PD FUZE	ANTIMONY SULFIDE	0.000256	0
		DINITROTOLUENE	0.333	2.36
		NITROCELLULOSE	2.4	17.03
		LEAD	0.00136	0.01
		TRINITROTOLUENE	6.78	48.12
		RDX	3.09	21.93
		DIBUTYLPHTHALATE	1.41	10
		DIPHENYLAMINE	0.0282	0.2
		TETRYL	0.00375	0.03
		POTASSIUM NITRATE	0.0317	0.23
1315-C445	105 MM HE M1 W/O FUZE	DINITROTOLUENE	0.333	2.61
		DIPHENYLAMINE	0.0282	0.22
		NITROCELLULOSE	2.4	18.79
		POTASSIUM NITRATE	0.0317	0.25

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C445	105 MM HE M1 W/O FUZE	RDX	3.05	23.87
		TRINITROTOLUENE	6.78	53.07
		DIBUTYLPHTHALATE	0.141	1.1
		CHARCOAL	0.00669	0.05
		POTASSIUM CHLORATE	0.000076	0
		SULFUR	0.00446	0.03
1315-C449	105 MM ILLUM M314 SERIES	BINDER	0.156	3.24
		DIBUTYLPHTHALATE	0.141	2.93
		NITROCELLULOSE	2.4	47.14
		MAGNESIUM POWDER	1.14	23.7
		SODIUM NITRATE	0.788	15.48
		POTASSIUM NITRATE	0.113	2.35
		DIPHENYLAMINE	0.0282	0.59
		CHARCOAL	0.0239	0.5
		LEAD	0.00134	0.03
		SULFUR	0.159	0.33
1315-C451	105 MM SMK GRN M84 SERIES	CHARCOAL	0.03	0.36
		ASBESTOS	0.13	1.6
		1,4-DI-P-TOLUIDINOANTHRAQUINON	1.57	19.2
		POTASSIUM NITRATE	0.14	1.6

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C451	105 MM SMK GRN M84 SERIES	POTASSIUM CHLORATE	1.6	19.6
		DINITROTOLUENE	0.28	3.4
		INERT	1.28	15.7
		DIBUTYLPHTHALATE	0.14	1.6
		YELLOW SMOKE B-10	0.55	6.7
		NITROCELLULOSE	2.4	29.4
1315-C452	105 MM SMK HC M84 SERIES	DINITROTOLUENE	0.275	2.6
		DIBUTYLPHTHALATE	0.11	1.1
		HEXACHLOROETHANE	3.375	32.3
		NITROCELLULOSE	2.3375	22.4
		POTASSIUM NITRATE	0.15	1.4
		LEAD	0.00066	0.01
		ALUMINUM	0.525	5
		CHARCOAL	0.029	0.28
		ZINC OXIDE	3.6	34.4
		SULFUR	0.02	0.19
1315-C454	105 MM SMK WP M60 SERIES	DIBUTYLPHTHALATE	0.11	1.65
		DIPHENYLAMINE	0.03	0.45
		DINITROTOLUENE	0.28	4.19
		NITROCELLULOSE	2.34	35.01

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C454	105 MM SMK WP M60 SERIES	LEAD	0.00123	1.65
		CHARCOAL	0.00669	0.1
		ANTIMONY SULFIDE	0.000081	0
		WHITE PHOSPHOROUS	3.83	57.3
		POTASSIUM	0.0318	0.47
		TETRYL	0.0495	0.74
1315-C462	105 MM HE M444	DIPHENYLAMINE	0.0282	0.74
		DINITROTOLUENE	0.282	7.37
		DIBUTYLPHTHALATE	0.141	3.68
		NITROCELLULOSE	2.4	62.72
		RDX	0.917	23.97
		STEARIC ACID	0.014	0.37
		CHARCOAL	0.00675	0.18
		LEAD	0.00134	0.04
		SULFUR	0.0045	0.12
		POTASSIUM NITRATE	0.032	0.84
1315-C477	105 MM SMK WP M60 SERIES W/O FUZE	DIBUTYLPHTHALATE	0.11	1.66
		DINITROTOLUENE	0.28	4.22
		ANTIMONY SULFIDE	0.000024	0
		DIPHENYLAMINE	0.03	0.45

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C477	105 MM SMK WP M60 SERIES W/O FUZE	NITROCELLULOSE	2.34	35.28
		LEAD THIOCYANATE	0.000036	0
		WHITE PHOSPHOROUS	3.83	57.74
		CHARCOAL	0.00669	0.1
		POTASSIUM	0.0318	0.48
		SULFUR	0.00446	0.07
1315-C494	105 MM APDS-T M728	NITROGLYCERIN	2.7	22.23
		ETHYL CENTRALITE	0.18	1.48
		NITROCELLULOSE	3.4097	28.08
		NITROGUANIDINE	5.724	47.14
		POTASSIUM	0.055059	0.45
		SULFUR	0.00765	0.06
		BARIUM PEROXIDE	0.003014	0.02
		LEAD THIOCYANATE	0.000131	0
		STRONTIUM NITRATE	0.005329	0.04
		MAGNESIUM POWDER	0.0057	0.05
1315-C503	105 MM TP-T M393A1	DINITROTOLUENE	0.59	4.73
		NITROCELLULOSE	5.015	40.18
		MAGNESIUM POWDER	0.015	0.12
		RDX	5.904	47.3

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C503	105 MM TP-T M393A1	STRONTIUM NITRATE	0.015	0.12
		BARIUM	0.0036	0.03
		DIBUTYLPHTHALATE	0.236	1.89
		DIPHENYLAMINE	0.059	0.47
		WAX	0.576	4.62
		POTASSIUM NITRATE	0.048	0.38
1315-C505	105 MM APDS-T M392A2	NITROCELLULOSE	3.41	28.14
		NITROGLYCERIN	2.7	22.28
		ETHYL CENTRALITE	0.181	1.49
		MAGNESIUM POWDER	0.0057	0.05
		NITROGUANIDINE	5.72	47.23
		STRONTIUM NITRATE	0.00533	0.04
		BARIUM PEROXIDE	0.00301	0.02
		GRAPHITE	0.012	0.1
		CHARCOAL	0.0118	0.1
		POTASSIUM NITRATE	0.0551	0.46
1315-C506	105 MM APDS-T M392/L36A1	CHARCOAL	0.011757	0.1
		NITROCELLULOSE	3.41	28.09
		ETHYL CENTRALITE	0.18	1.48
		NITROGLYCERIN	2.7	22.24

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C506	105 MM APDS-T M392/L36A1	NITROGUANIDINE	5.72	47.15
		POTASSIUM NITRATE	0.055059	0.45
		BARIUM PEROXIDE	0.003014	0.02
		MAGNESIUM POWDER	0.0057	0.05
		SULFUR	0.00765	0.06
		STRONTIUM NITRATE	0.005329	0.04
1315-C508	105 MM HEAT-T M456 SERIES	ETHYL CENTRALITE	0.173	1.26
		NITROGLYCERIN	2.56	18.86
		NITROCELLULOSE	3.25	23.66
		NITROGUANIDINE	5.49	39.65
		RDX	1.284	9.35
		TRINITROTOLUENE	0.835	6.08
		TETRYL	0.164	0.12
		STRONTIUM NITRATE	0.00533	0.04
		MAGNESIUM POWDER	0.005732	0.04
		POTASSIUM NITRATE	0.0316	0.23
1315-C510	105 MM TP-T M467	DIPHENYLAMINE	0.059	0.98
		DIBUTYLPHTHALATE	0.295	4.91
		DINITROTOLUENE	0.59	9.82
		MAGNESIUM POWDER	0.014643	0.24

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C510	105 MM TP-T M467	NITROCELLULOSE	5.015	83.55
		POTASSIUM NITRATE	0.047889	0.8
		BARIUM PEROXIDE	0.003571	0.06
		CHARCOAL	0.010096	0.17
		STRONTIUM NITRATE	0.014586	0.24
		SULFUR	0.00673	0.11
1315-C511	105 MM TP-T M490/M456E1	NITROCELLULOSE	3.25	28.11
		NITROGLYCERIN	2.59	22.38
		ETHYL CENTRALITE	0.173	1.5
		SULFUR	0.0045	0.04
		POTASSIUM	0.0318	0.28
		NITROGUANIDINE	5.49	47.45
		BARIUM PEROXIDE	0.000351	0.03
		STRONTIUM NITRATE	0.00533	0.05
		TETRYL	0.0164	0.14
		MAGNESIUM POWDER	0.0057	0.05
1315-C512	105 MM SMK WP-T M416 W/BD FUZE	DIPHENYLAMINE	0.059	0.48
		DINITROTOLUENE	0.59	4.84
		DIBUTYLPHTHALATE	0.295	2.42
		NITROCELLULOSE	5.015	41.13

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C512	105 MM SMK WP-T M416 W/BD FUZE	RDX	0.14644	1.2
		WHITE PHOSPHOROUS	6	49.2
		MAGNESIUM POWDER	0.014643	0.12
		TRINITROTOLUENE	0.043001	0.35
		STRONTIUM NITRATE	0.014586	0.12
		POTASSIUM NITRATE	0.047889	0.39
1315-C513	105 MM APERS-T M546	DIPHENYLAMINE	0.0279	0.9
		DINITROTOLUENE	0.217	7
		GRAPHITE	0.0062	0.2
		NITROCELLULOSE	2.83	91.4
		POTASSIUM SULFATE	0.0186	0.6
1315-C518	105 MM HEP-T M393A2	DIBUTYLPHTHALATE	0.24	1.91
		DIPHENYLAMINE	0.06	0.49
		DINITROTOLUENE	0.59	4.67
		NITROCELLULOSE	5.02	39.8
		RDX	6.01	47.66
		CHARCOAL	0.01	0.08
		WAX	0.59	4.67
		POTASSIUM NITRATE	0.05	0.4
		STRONTIUM NITRATE	0.01	0.08

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C518	105 MM HEP-T M393A2	MAGNESIUM POWDER	0.01	0.08
1315-C519	105MM APERS-T M494 SERIES	DIBUTYLPHTHALATE	0.276	2.94
		DINITROTOLUENE	0.92	9.82
		DIPHENYLAMINE	0.092	0.98
		CHARCOAL	0.0101	0.11
		NITROCELLULOSE	8	85.39
		POTASSIUM NITRATE	0.0479	0.51
		BARIUM	0.00302	0.03
		SULFUR	0.00673	0.07
		MAGNESIUM POWDER	0.0057	0.06
		STRONTIUM NITRATE	0.00533	0.06
1315-C521	105 MM APFSDS-T CARTRIDGE M735	GRAPHITE	0.01	0.08
		ETHYL CENTRALITE	0.19	1.52
		NITROCELLULOSE	3.5	28.07
		NITROGLYCERIN	2.81	22.53
		NITROGUANIDINE	5.96	47.79
	105MM APFSDS-T M735	NITROGLYCERIN	2.81	22.53
		ETHYL CENTRALITE	0.19	1.52
		NITROCELLULOSE	3.5	28.03
		GRAPHITE	0.01	0.08

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C521	105MM APFSDS-T M735	STRONTIUM NITRATE	0.00533	0
		NITROGUANIDINE	5.96	47.79
		BARIUM PEROXIDE	0.00301	0
		PERCHLOROPENTACYCLODECANE	0.000843	0
		MAGNESIUM POWDER	0.0057	0
		VINYL ALCOHOL ACETATE RESIN	0.000843	0
1315-C523	105MM APFSDS-T M774	GRAPHITE	0.01	0.08
		NITROCELLULOSE	3.64	28
		ETHYL CENTRALITE	0.2	1.54
		NITROGLYCERIN	2.93	22.54
		STRONTIUM NITRATE	0.00533	0
		NITROGUANIDINE	6.2	47.71
		BARIUM PEROXIDE	0.0301	0
		MAGNESIUM POWDER	0.0561	0
		VINYL ALCOHOL ACETATE RESIN	0.000843	0
		PERCHLOROPENTACYCLODECANE	0.000843	0
1315-C650	106MM HEAT M344A1 W/PIBD FUZE	NITROCELLULOSE	5.42	49.9
		NITROGLYCERIN	2.02	18.6
		TETRYL	0.016	0.15
		POTASSIUM NITRATE	0.0629	0.61

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C650	106MM HEAT M344A1 W/PIBD FUZE	RDX	1.674	15.4
		ETHYL CENTRALITE	0.48	4.4
		BARIUM NITRATE	0.064	0.55
		TRINITROTOLUENE	1.081	9.9
		LEAD	0.000286	0
		PETN	0.00035	0
1315-C651	106MM HEP-T M346 SERIES	MAGNESIUM POWDER	0.0369	0.23
		NITROCELLULOSE	7.87	49.43
		POTASSIUM SULFATE	0.0804	0.51
		STRONTIUM NITRATE	0.0588	0.36
		RDX	7.025	44.12
		ALUMINUM	0.00181	0.01
		WAX	0.695	4.37
		DIPHENYLAMINE	0.0804	0.51
		ANTIMONY SULFIDE	0.000106	0
		TETRYL	0.0451	0.28
1315-C660	106MM APERS-T M581	DINITROTOLUENE	0.564	7
		DIPHENYLAMINE	0.0726	0.9
		NITROCELLULOSE	7.37	91.4
		GRAPHITE	0.0161	0.2

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C660	106MM APERS-T M581	POTASSIUM SULFATE	0.0484	0.6
1315-C697	4.2 IN HE M329A2 W/O FUZE	NITROGLYCERIN	0.258	3.83
		NITROCELLULOSE	0.313	4.65
		RDX	3.45	51.19
		POTASSIUM NITRATE	0.0266	0.4
		TRINITROTOLUENE	2.61	38.69
		ETHYL CENTRALITE	0.0036	0.05
		WAX	0.0575	0.85
		CHARCOAL	0.00375	0.06
		SULFUR	0.0025	0.04
		METHYLPHTHALATE	0.018	0.27
1315-C699		NITROGLYCERIN	0.258	3.83
		NITROCELLULOSE	0.313	4.65
		RDX	3.45	51.19
		POTASSIUM NITRATE	0.0266	0.4
		TRINITROTOLUENE	2.61	38.69
		WAX	0.0575	0.85
		CHARCOAL	0.00375	0.06
		ETHYL CENTRALITE	0.0036	0.05
		METHYLPHTHALATE	0.018	0.27

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C699	4.2 IN HE M329A2 W/O FUZE	SULFUR	0.0025	0.04
1315-C703	4.2 IN H/HD M2 SERIES	DIETHYLPHTHALATE	0.0129	0.18
		NITROGLYCERIN	0.192	2.6
		ETHYL CENTRALITE	0.00271	0.04
		NITROCELLULOSE	0.234	3.17
		POTASSIUM CHLORATE	0.000037	0
		POTASSIUM NITRATE	0.00584	0.08
		LEAD AZIDE	0.000361	0
		GASOLINE	6.2	84.04
		CARBORUNDUM	0.000007	0
		ANTIMONY SULFIDE	0.000037	0
1315-C704	4.2 IN HE M329 SERIES W/PD FUZE	DIETHYLPHTHALATE	0.018	0.2
		NITROCELLULOSE	0.323	3.63
		NITROGLYCERIN	0.265	2.98
		RDX	0.0458	0.52
		TRINITROTOLUENE	8.17	91.9
		TETRYL	0.0495	0.56
		BARIUM CHROMATE	0.00006	0
		POTASSIUM	0.00865	0.1
1315-C705	4.2 IN HE M329 SERIES W/O FUZE	NITROCELLULOSE	0.323	3.68

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C705	4.2 IN HE M329 SERIES W/O FUZE	NITROGLYCERIN	0.265	3.02
		ETHYL CENTRALITE	0.00373	0.04
		LEAD AZIDE	0.000016	0
		TRINITROTOLUENE	8.17	93.2
		POTASSIUM NITRATE	0.00805	0.09
		ANTIMONY SULFIDE	0.000004	0
		DIETHYLPHTHALATE	0.018	0.21
		POTASSIUM CHLORATE	0.000016	0
1315-C706	4.2 IN ILLUM M335 SERIES	MAGNESIUM	1.92	44.86
		NITROGLYCERIN	0.265	6.19
		NITROCELLULOSE	0.323	7.55
		SODIUM NITRATE	1.32	30.84
		POTASSIUM CHLORATE	0.141	3.29
		DIETHYLPHTHALATE	0.018	0.42
		WAX	0.265	6.19
		CHARCOAL	0.0281	0.66
1315-C708	4.2 IN SMK WP M2/M328 SERIES W/PD FUZE	DIETHYLPHTHALATE	0.018	0.2
		NITROGLYCERIN	0.265	2.87
		NITROCELLULOSE	0.323	3.49
		RDX	0.126	1.36

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C708	4.2 IN SMK WP M2/M328 SERIES W/PD FUZE	LEAD AZIDE	0.0121	0.01
		TRINITROTOLUENE	0.0831	0.9
		WHITE PHOSPHOROUS	8.4	90.81
		ANTIMONY SULFIDE	0.000057	0
		POTASSIUM NITRATE	0.0081	0.09
		TETRYL	0.0152	0.16
1315-C709	M6 PROPELLANT CHARGE FOR 4.2 IN MORTAR	DIBUTYLPHTHALATE	0	2.98
		DINITROTOLUENE	0	9.93
		DIPHENYLAMINE	0	0.99
		NITROCELLULOSE	0	86.1
1315-C710	4.2 IN CS M630 W/MTSQ FUZE	CHLOROBENZALDEHYDE	3.84	82.4
		DIBUTYLPHTHALATE	0.018	0.39
		MALONONITRILE	0.04	0.86
		NITROCELLULOSE	0.323	6.93
		NITROGLYCERIN	0.265	5.69
		POTASSIUM NITRATE	0.127	2.73
		LEAD	0.0013	0.03
		CHARCOAL	0.025	0.54
		ANTIMONY SULFIDE	0.000047	0
		SULFUR	0.0167	0.36

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C713	IGNITION M2 F/4.2 MORTAR	NITROGLYCERIN	0.007	40
		NITROCELLULOSE	0.0101	57.8
		ETHYL CENTRALITE	0.00014	0.8
		POTASSIUM NITRATE	0.000263	1.5
1315-C751	PROJ M53/M53A1 F/105MM WP CTG	TETRYL	0.1575	75
		TRINITROTOLUENE	0.0525	25
1315-C800	120MM HE T15E3	DIBUTYLPHTHALATE	0.558	2.73
		NITROCELLULOSE	2.48	12.13
		NITROGLYCERIN	2.36	11.53
		RDX	4.7	22.99
		NITROGUANIDINE	6.78	33.19
		TRINITROTOLUENE	3.06	14.97
		LEAD	0.0012	0.01
		ALUMINUM	0.000086	0
		BARIUM CHROMATE	0.00006	0
		STRONTIUM NITRATE	0.0028	0.01
1315-C801	120MM HE M356	DIBUTYLPHTHALATE	0.558	2.73
		NITROGLYCERIN	2.36	11.53
		NITROCELLULOSE	2.48	12.13
		RDX	4.7	22.99

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C801	120MM HE M356	NITROGUANIDINE	6.78	33.19
		LEAD	0.0012	0.01
		TRINITROTOLUENE	3.06	14.97
		BARIUM CHROMATE	0.00006	0
		ALUMINUM	0.000086	0
		STRONTIUM NITRATE	0.0028	0.01
1315-C804	120MM TP-T M359	CRYOLITE	0.087	0.3
		GRAPHITE	0.029	0.1
		NITROCELLULOSE	6.38	21.89
		ETHYL CENTRALITE	0.435	1.49
		NITROGLYCERIN	6.24	21.39
		NITROGUANIDINE	15.863	54.42
		CHARCOAL	0.022286	0.08
		POTASSIUM NITRATE	0.10571	0.36
		STRONTIUM NITRATE	0.0028	0.01
		SULFUR	0.014857	0.05
1315-C806	120MM SMK WP-T T16E3	DIBUTYLPHTHALATE	0.558	2.73
		NITROGLYCERIN	2.356	11.53
		NITROCELLULOSE	2.48	12.14
		NITROGUANIDINE	6.7828	33.19

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C806	120MM SMK WP-T T16E3	2-NITROPHENYLAMINE	0.186	0.91
		CRYOLITE	0.0372	0.18
		WHITE PHOSPHOROUS	7.5	36.7
		TRINITROTOLUENE	0.1821	0.3
		POTASSIUM NITRATE	0.10571	0.52
		TETRYL	0.1103	1.13
1315-C807	120MM HEAT-T M469	DINITROTOLUENE	2.2	8.24
		DIBUTYLPHTHALATE	0.66	2.47
		NITROCELLULOSE	19.14	71.72
		LEAD THIOCYANATE	0.00029	0
		RDX	2.71	10.14
		DIPHENYLAMINE	0.22	0.82
		BARIUM PEROXIDE	0.00301	0.01
		TRINITROTOLUENE	1.76	6.59
		STRONTIUM NITRATE	0.00533	0.02
		MAGNESIUM POWDER	0.0057	0.02
1315-C995	84MM M136 AT-4	BORON	0	0.1
		ETHYL CENTRALITE	0	0.7
		NITROCELLULOSE	0	28
		RDX	0	1.2

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1315-C995	84MM M136 AT-4	NITROGLYCERIN	0	16
		POTASSIUM NITRATE	0	0.5
		HMX	0	16
		OCTOL	0	37
1315-F382	ADAPTER BOOSTER BOMB MOD TA6E4	TETRYL	0	100
1320-D151	PROJ M71 F/GAS PROJ 155MM	RDX	1.47	60
		WAX	0.02	1
		TRINITROTOLUENE	0.96	39
1320-D152	PROJ XM54 BURSTER	TETRYL	0.345	75
		TRINITROTOLUENE	0.115	25
1320-D153	PROJ M83	RDX	4.2	60
		TRINITROTOLUENE	2.73	39
		WAX	0.07	1
1320-D381	152MM HEAT-T M409 SERIES	BARIUM PEROXIDE	0.0063	0.05
		MAGNESIUM POWDER	0.0113	0.09
		LEAD AZIDE	0.00017	0
		RDX	3.83	30.9
		STRONTIUM NITRATE	0.011	0.09
		ETHYL CENTRALITE	0.36	2.91
		TRINITROTOLUENE	2.46	19.87

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D381	152MM HEAT-T M409 SERIES	NITROCELLULOSE	4.122	33.3
		NITROGLYCERIN	1.5	12.11
		TETRYL	0.0017	0.01
1320-D383	152MM TP-T M411 SERIES	BARIUM PEROXIDE	0.0063	0.1
		NITROCELLULOSE	4.122	64.61
		NITROGLYCERIN	1.5	23.51
		ETHYL CENTRALITE	0.36	5.66
		MAGNESIUM POWDER	0.0113	0.18
		TRINITROTOLUENE	0.3	4.7
		CALCIUM RESINATE	0.00015	0
		LEAD	0.001197	0.02
		STRONTIUM NITRATE	0.011	0.17
		PERCHLOROPENTACYCLODECANE	0.0018	0.03
1320-D445	SMK HC M1 F/155MM M116 SERIES	ALUMINUM POWDER	0.39	6
		HEXACHLOROETHANE	2.97	46
		ZINC OXIDE	3.1	48
1320-D446	SMK GRN M3 F/155MM M116	DIPHENYLAMINE	0.05	1
		DINITROTOLUENE	0.5	10
		DIBUTYLPHTHALATE	0.2	4
		NITROCELLULOSE	4.25	85

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D447	SMK RED M3 F/155MM M116	DIPHENYLAMINE	0.05	1
		DIBUTYLPHTHALATE	0.2	4
		DINITROTOLUENE	0.5	10
		NITROCELLULOSE	4.25	85
1320-D448	SMK VI0 M3 F/155MM M116	DINITROTOLUENE	0.5	10
		DIBUTYLPHTHALATE	0.2	4
		DIPHENYLAMINE	0.05	1
		NITROCELLULOSE	4.25	85
1320-D449	SMK YLW M3 F/155MM M116	DINITROTOLUENE	0.5	10
		DIPHENYLAMINE	0.05	1
		DIBUTYLPHTHALATE	0.2	4
		NITROTOLUENE	4.25	85
1320-D451	SMK GRN M4 F/155MM M116	DINITROTOLUENE	1.35	10
		DIPHENYLAMINE	0.13	1
		DIBUTYLPHTHALATE	0.54	4
		NITROCELLULOSE	11.46	85
1320-D452	SMK RED M4 F/155MM M116	DINITROTOLUENE	1.35	10
		DIPHENYLAMINE	0.13	1
		DIBUTYLPHTHALATE	0.54	4
		NITROCELLULOSE	11.46	85

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D453	SMK VI0 M4 F/155MM M116	DIPHENYLAMINE	0.13	1
		DIBUTYLPHTHALATE	0.54	4
		DINITROTOLUENE	1.35	10
		NITROCELLULOSE	11.46	85
1320-D454	SMK YLW M4 F/155MM M116	DIBUTYLPHTHALATE	0.54	4
		DINITROTOLUENE	1.35	10
		DIPHENYLAMINE	0.13	1
		NITROCELLULOSE	11.46	85
1320-D485	155MM HE M101	BARIUM	0.000069	0
		ANTIMONY SULFIDE	0.000057	0
		LEAD	0.0012	0.01
		TETRACENE	0.000003	0
		POTASSIUM CHLORATE	0.00005	0
		TRINITROTOLUENE	14.98	99.67
		CARBORUNDUM	0.000007	0
		BORON POWDER	0.000011	0
		TETRYL	0.0495	0.33
1320-D503	155MM HE RAAM-L M718	BARIUM NITRATE	0.000027	0
		ESTANE	0.57	5.01
		NITROCELLULOSE	0.019	0.17

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D503	155MM HE RAAM-L M718	NITROGLYCERIN	0.00902	0.07
		POTASSIUM	0.00234	0
		RDX	10.77	94.72
		LEAD STYPHNATE	0.000031	0
		ETHYL CENTRALITE	0.000157	0
		CHARCOAL	0.000423	0
		SULFUR	0.000283	0
1320-D505	155MM ILLUM M485 SERIES	MAGNESIUM POWDER	0	0.05
		BARIUM NITRATE	0	0.07
		LINSEED OIL	0	0.01
		HEXACHLOROBENZENE	0	0.03
		POTASSIUM PERCHLORATE	0	0.04
		STRONTIUM NITRATE	0	0.02
		DEXTRIN	0	0.02
		DINITROTOLUENE	0	9.86
		SODIUM OXALATE	0	0.05
		NITROCELLULOSE	0	83.85
1320-D509	155MM HE RAAM-S M741	ESTANE	0.57	5.01
		BARIUM NITRATE	0.000027	0
		NITROGLYCERIN	0.00902	0.07

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D509	155MM HE RAAM-S M741	NITROCELLULOSE	0.019	0.17
		POTASSIUM	0.00234	0
		RDX	10.77	94.72
		CHARCOAL	0.000423	0
		LEAD STYPHNATE	0.000031	0
		ETHYL CENTRALITE	0.000157	0
		SULFUR	0.000283	0
1320-D510	155MM HEAT M712 (COPPERHEAD)	DIBUTYLPHTHALATE	0.6143	1.74
		DINITROTOLUENE	2.0475	5.81
		NITROCELLULOSE	17.8136	50.57
		RDX	8.85	25.12
		TRINITROTOLUENE	5.7525	16.33
		DIPHENYLAMINE	0.2048	0.58
		CHARCOAL	0.00049	0
		WAX	0.1475	0.42
		POTASSIUM NITRATE	0.002326	0.01
		SULFUR	0.000327	0
1320-D512	XM54 PROJECTILE BURSTER	TETRYL	0.345	75
		TRINITROTOLUENE	0.115	25
1320-D532	PROP 155MM RB M203 SERIES	DIPHENYLAMINE	0.23681	0.89

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D532	PROP 155MM RB M203 SERIES	DINITROTOLUENE	1.84188	6.9
		NITROCELLULOSE	24.04963	90.13
		LEAD	0.34375	1.29
		GRAPHITE	0.05263	0.2
		POTASSIUM SULFATE	0.15788	0.59
1320-D533	PROP 155MM RB M119 SERIES W/O PRIMER	DIBUTYLPHTHALATE	0.41	2
		DIPHENYLAMINE	0.205	1
		DINITROTOLUENE	2.048	10
		NITROCELLULOSE	17.814	87
1320-D534	PROP 155MM WB M119/119E4 W/PRIMER	DINITROTOLUENE	2.0475	9.81
		CHARCOAL	0.0005	0
		DIPHENYLAMINE	0.2048	0.98
		DIBUTYLPHTHALATE	0.6143	2.94
		NITROCELLULOSE	17.8136	85.35
		POTASSIUM NITRATE	0.0023	0.01
		LEAD	0.1875	0.9
		SULFUR	0.0003	0
1320-D540	PROP 155MM GB M3 SERIES	DIBUTYLPHTHALATE	0.1998	0.4
		DINITROTOLUENE	0.4994	10
		DIPHENYLAMINE	0.0499	1

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D540	PROP 155MM GB M3 SERIES	NITROCELLULOSE	4.2449	85
1320-D541	PROP 155MM WB M4 SERIES	DIPHENYLAMINE	0.135	1
		DINITROTOLUENE	1.348	10
		DIBUTYLPHTHALATE	0.539	4
		NITROCELLULOSE	11.461	85
1320-D543	155MM H OR HD (CHEMICAL AGENTS) M110	ANTIMONY SULFIDE	0.000057	0
		BARIUM CHROMATE	0.00006	0
		LEAD AZIDE	0.001184	0.01
		HD	11.7	93
		TETRYL	0.6695	5.32
		TRINITROTOLUENE	0.21	1.67
		BARIUM NITRATE	0.000009	0
		BORON POWDER	0.000011	0
		CARBORUNDUM	0.000007	0
		POTASSIUM CHLORATE	0.00005	0
1320-D544	155MM HE M107 (TNT) 00-529-7331	DINITROTOLUENE	2.05	5.78
		DINITROTOLUENE	2.05	5.82
		DIBUTYLPHTHALATE	0.41	1.16
		DIBUTYLPHTHALATE	0.41	1.16
		NITROCELLULOSE	17.82	50.56

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D544	155MM HE M107 (TNT) 00-529-7331	NITROCELLULOSE	17.82	50.27
		LEAD	0.00135	0
		RDX	0.0458	0.13
		RDX	0.0458	0.13
		TETRYL	0.00375	0.01
		DIPHENYLAMINE	0.205	0.58
		TRINITROTOLUENE	14.91	42.3
		TRINITROTOLUENE	14.91	42.06
		POTASSIUM NITRATE	0.00201	0.01
		POTASSIUM CHLORATE	0.000606	0
		POTASSIUM NITRATE	0.00201	0.01
		TETRYL	0.00375	0.01
1320-D550	155MM SMK WP M105/M110 SERIES	DIPHENYLAMINE	0.31	0.65
		DINITROTOLUENE	3.1	6.52
		LEAD	0.00135	0
		NITROCELLULOSE	26.97	56.8
		TETRYTOL	0.83	1.75
		WHITE PHOSPHOROUS	15.6	32.85
		FERRIC NITRATE	0.002	0
		DIBUTYLPHTHALATE	0.62	1.3

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D550	155MM SMK WP M105/M110 SERIES	TETRYL	0.00375	0.01
		RDX	0.0457	0.1
1320-D552	FLASH M2 F/155MM PROP CHG	CHARCOAL	0.00468	7.8
		POTASSIUM NITRATE	0.0552	87
		SULFUR	0.00312	5.2
1320-D563	155MM HE APER M483 SERIES	ETHYL CENTRALITE	0.08	0.25
		NITROCELLULOSE	7.26	22.36
		NITROGLYCERIN	6.21	19.13
		STEARIC ACID	0.0958	0.3
		RDX	6.26	19.28
		NITROGUANIDINE	12.17	37.48
		LEAD	0.000936	0
		ANTIMONY SULFIDE	0.000034	0
		CRYOLITE	0.39	1.2
		BARIUM NITRATE	0.000048	0
1320-D568	155MM GAS VX OR GB (CHEMICAL AGENTS) M121	CALCIUM SILICATE	0.01225	0.13
		LEAD AZIDE	0.000777	0.01
		GB	6.5	69.91
		RDX	1.5159	16.3
		LEAD STYPHNATE	0.000087	0

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D568	155MM GAS VX OR GB (CHEMICAL AGENTS) M121	WAX	0.000699	0.01
		BARIUM NITRATE	0.000044	0
		TRINITROTOLUENE	1.2678	13.63
		ANTIMONY SULFIDE	0.000033	0
		BARIUM CHROMATE	0.00006	0
1320-D569	155MM HE M101	ANTIMONY SULFIDE	0.000057	0
		LEAD	0.0012	0.01
		TRINITROTOLUENE	15.48	99.68
		POTASSIUM CHLORATE	0.00005	0
		TETRACENE	0.000003	0
		TETRYL	0.0495	0.32
		CARBORUNDUM	0.000007	0
		BORON POWDER	0.000011	0
		BARIUM	0.000069	0
1320-D570	165MM HEP M123A1 (COMP A-3)	BARIUM NITRATE	0.02968	0.16
		NITROGLYCERIN	0.4134	2.27
		NITROCELLULOSE	1.643	9.03
		RDX	14.56	79.98
		POTASSIUM CHLORATE	0.0814	0.45
		ETHYL CENTRALITE	0.01272	0.07

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D570	165MM HEP M123A1 (COMP A-3)	GRAPHITE	0.00636	0.03
		WAX	1.44	7.91
		ANTIMONY SULFIDE	0.000081	0
		POTASSIUM NITRATE	0.01696	0.09
1320-D572	175MM HE M437A1/437A2 (TNT)	DIBUTYLPHTHALATE	1.14	1.31
		DINITROTOLUENE	5.7	6.52
		LEAD	0.00211	0
		NITROCELLULOSE	49.59	56.76
		POTASSIUM NITRATE	0.00232	0
		BARIUM CHROMATE	0.00006	0
		CHARCOAL	0.00049	0
		TRINITROTOLUENE	30.365	34.75
		ANTIMONY SULFIDE	0.000057	0
		SULFUR	0.000327	0
1320-D579	155MM HE RAP M549 SERIES (COMP B)	DINITROTOLUENE	1.312	4.3
		NITROCELLULOSE	11.152	36.52
		TETRYL	0.0495	0.16
		RDX	9.6	31.43
		TRINITROTOLUENE	6.607	21.63
		DIBUTYLPHTHALATE	0.5248	1.72

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D579	155MM HE RAP M549 SERIES (COMP B)	LEAD	0.00123	0
		WAX	0.16	0.52
		DIPHENYLAMINE	0.1312	0.04
		POTASSIUM SULFATE	0.001	0
1320-D591	175MM HE M437A2 (COMP B)	DIBUTYLPHTHALATE	1.14	1.3
		DINITROTOLUENE	5.7	6.47
		DIPHENYLAMINE	0.57	0.65
		NITROCELLULOSE	49.59	56.31
		RDX	18.6	21.12
		LEAD	0.002107	0
		ANTIMONY SULFIDE	0.000057	0
		BARIUM CHROMATE	0.00006	0
		TRINITROTOLUENE	12.455	14.14
		POTASSIUM NITRATE	0.0023	0
1320-D592	152MM HE M657E2	GRAPHITE	0.018	0.12
		NITROCELLULOSE	4.122	26.48
		NITROGLYCERIN	1.5	9.64
		ETHYL CENTRALITE	0.36	2.31
		TETRYL	0.050861	0.33
		TRINITROTOLUENE	9.5	61.02

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D592	152MM HE M657E2	LEAD AZIDE	0.001843	0.01
		BARIUM PEROXIDE	0.003014	0.02
		STRONTIUM NITRATE	0.005328	0.03
		MAGNESIUM POWDER	0.0057	0.04
1320-D651	8 IN HE DPICM M509/509E1	DIPHENYLAMINE	0.28	0.53
		DINITROTOLUENE	2.83	5.39
		NITROCELLULOSE	24.05	45.83
		LEAD	0.022	0.04
		RDX	23.767	45.3
		STEARIC ACID	0.36	0.69
		DIBUTYLPHTHALATE	1.13	2.15
		BARIUM NITRATE	0.001	0
		ANTIMONY SULFIDE	0.0008	0
		POTASSIUM NITRATE	0.0023	0
1320-D662	PROP 8 IN WB M188A1 W/O PRIMER	2-NITROPHENYLAMINE	0.72	1.47
		DIBUTYLPHTHALATE	2.16	4.4
		CRYOLITE	0.144	0.29
		NITROGLYCERIN	9.12	18.56
		NITROCELLULOSE	9.6	19.54
		NITROGUANIDINE	26.256	53.45

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D662	PROP 8 IN WB M188A1 W/O PRIMER	LEAD	0.75	1.53
		CHARCOAL	0.056	0.11
		SULFUR	0.038	0.08
		POTASSIUM NITRATE	0.283	0.58
1320-D675	PROP 8 IN GB M1	DIPHENYLAMINE	0.133	1
		DIBUTYLPHTHALATE	0.532	4
		DINITROTOLUENE	1.33	10
		NITROCELLULOSE	11.305	85
1320-D676	PROP 8 IN WB M2	DINITROTOLUENE	2.83	10
		DIBUTYLPHTHALATE	1.132	4
		DIPHENYLAMINE	0.283	1
		NITROCELLULOSE	24.055	85
1320-D680	8 IN HE M106	DIPHENYLAMINE	0.49	0.57
		DIBUTYLPHTHALATE	2.45	2.84
		DINITROTOLUENE	4.9	5.72
		NITROCELLULOSE	41.65	48.59
		RDX	0.0458	0.05
		TRINITROTOLUENE	36.67	42.77
		ANTIMONY SULFIDE	0.000214	0
		LEAD	0.00136	0

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1320-D680	8 IN HE M106	POTASSIUM NITRATE	0.00201	0
		TETRYL	0.00375	0
1320-D681	FLASH M3 F/8-IN PROP CHARGE	CHARCOAL	0.15	15
		POTASSIUM NITRATE	0.75	75
		SULFUR	0.1	1
1325-E463	GP 250 LB MK81 MOD 1 H-6/TRITONAL	ALUMINUM POWDER	20	20
		TRINITROTOLUENE	80	80
1325-E464	GP 250 LB MK81 MOD 0 TRITONAL	ALUMINUM POWDER	20	20
		TRINITROTOLUENE	80	80
1325-E465	GP 250 LB MK81 MOD 1 H-6/TRITONAL	ALUMINUM POWDER	20	20
		TRINITROTOLUENE	80	80
1325-E480	GP 500 LB MK82 MOD 1	ALUMINUM POWDER	38.4	20
		WAX	9.6	5
		RDX	86.4	45
		TRINITROTOLUENE	57.6	30
1325-E485	GP 500 LB MK82 MOD 1 TRITONAL	ALUMINUM POWDER	38.4	20
		TRINITROTOLUENE	153.6	80
1325-E506	GP 1000 LB MK83 MOD 4	CALCIUM CHLORIDE	1.34	0.3
		NITROCELLULOSE	3.12	0.7
		PARAFFIN	17.8	4

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1325-E506	GP 1000 LB MK83 MOD 4	RDX	200.25	45
		ALUMINUM POWDER	89	20
		TRINITROTOLUENE	133.5	30
		LECITHIN	0.45	0.1
1325-E807	ACFT LS FAE CBU 55/B	ETHYLENE OXIDE	216	98.92
		PETN	2.36	1.08
1325-E820	ACFT CBU 59/B	HMX	80.46	94
		NYLON	5.14	6
1325-F372	BOOSTER T45E7	TETRYL	0.43	100
1325-F382	BOOSTER BOMB T46E3/E3	TETRYL	0.904	100
1325-F562	SIGNAL MK4 MOD 0/1/3	DINITROCELLULOSE	0.00386	7
		DIPHENYLAMINE	0.000497	0.9
		NITROCELLULOSE	0.05	91.4
		GRAPHITE	0.00011	0.2
		POTASSIUM SULFATE	0.000331	0.6
1325-F680	BOMB NOSE M904E2	LEAD AZIDE	0.00088	0.53
		TETRYL	0.00044	0.27
		RDX	0.162	97.59
		WAX	0.00247	1.49
1325-F835	BOMB NOSE M904 E2/E3	BARIUM CHROMATE	0.00015	0.09

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1325-F835	BOMB NOSE M904 E2/E3	LEAD	0.00103	0.63
		POTASSIUM PERCHLORATE	0.000037	0.02
		RDX	0.162	98.92
		TETRYL	0.00044	0.27
		ZIRCONIUM POWDER	0.000077	0.05
		RAREOX	0.00003	0.02
1325-F989	BOMB TAIL M905	BARIUM CHROMATE	0.000157	0.02
		LEAD AZIDE	0.00103	0.12
		RAREOX	0.000029	0
		POTASSIUM PERCHLORATE	0.000037	0
		TETRYL	0.89	99.85
		ZIRCONIUM POWDER	0.000077	0.01
1330-G815	SMK SCREENING RP UK L8A3 01-124-5031	CHARCOAL	0.00567	0.68
		BUTYL RUBBER	0.0397	4.77
		RED PHOSPHOROUS	0.754	90.63
		POTASSIUM NITRATE	0.0284	3.41
		SULFUR	0.00378	0.45
1330-G839	GREN RIFLE 7.62MM M64	CHARCOAL	0.00088	15
		POTASSIUM NITRATE	0.0044	75
		SULFUR	0.00059	10

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1330-G870	HAND GREN PRAC M205	CHARCOAL	0.0006	15
		POTASSIUM NITRATE	0.0033	75
		SULFUR	0.0004	10
1330-G872	HAND GREN OFF M206/M6	PETN	0.0062	100
1330-G873	HAND GREN FRAG M204 SERIES	RDX	0.00712	100
1330-G874	HAND GREN M201A1	BARIUM NITRATE	0.000006	0.13
		LEAD	0.0026	59.1
		MAGNESIUM POWDER	0.0006	13.63
		POTASSIUM CHLORATE	0.00002	0.45
		POTASSIUM PERCHLORATE	0.00001	0.23
		FERRIC OXIDE	0.000017	0.39
		TRINITROTOLUENE	0.000003	0.06
		IRON OXIDE	0.0002	4.54
		ZIRCONIUM POWDER	0.000073	1.66
		SILICON	0.0006	13.64
1330-G877	HAND GREN M213	ANTIMONY SULFIDE	0.000006	0.12
		BARIUM	0.000103	2.2
		ALUMINUM POWDER	0.000006	0.12
		LEAD	0.0016	34.15
		TETRACENE	0.000003	0.06

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1330-G877	HAND GREN M213	RDX	0.0029	61.9
		CALCIUM STEARATE	0.000006	0.12
		NICKEL POWDER	0.000023	0.49
		POTASSIUM PERCHLORATE	0.000021	0.45
		ZIRCONIUM POWDER	0.000018	0.38
1330-G878	HAND GREN PRAC M228	CHARCOAL	0.00068	15
		SULFUR	0.00044	10
		POTASSIUM NITRATE	0.00334	75
1330-G880	HAND FRAG M61	BARIUM	0.00172	0.32
		LEAD	0.00073	0.14
		RDX	0	38.8
		TETRYL	0.187	34.89
		TRINITROTOLUENE	0.134	25.28
		WAX	0.003	0.56
		ZIRCONIUM POWDER	0.000325	0.06
		POTASSIUM CHLORATE	0.000027	0
		NICKEL POWDER	0.000417	0.08
		POTASSIUM PERCHLORATE	0.0004	0.07
1330-G881	HAND FRAG M67	ANTIMONY SULFIDE	0.000014	0
		BARIUM CHROMATE	0.000094	0

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1330-G881	HAND FRAG M67	LEAD	0.00162	0
		RDX	0.247	60.24
		TRINITROTOLUENE	0.158	38.54
		WAX	0.004	0.01
		POTASSIUM CHLORATE	0.000027	0
		NICKEL POWDER	0.000023	0
		POTASSIUM PERCHLORATE	0.000021	0
		ZIRCONIUM POWDER	0.000019	0
1330-G888	GRENADE HAND FRAG M67	LEAD AZIDE	0	0.3
		LEAD STYPHNATE	0	0.1
		RDX	0	60
		TRINITROTOLUENE	0	38.5
1330-G890	HAND FRAG MK2/M26 SERIES	BARIUM	0.00172	0.35
		LEAD	0.000729	0.15
		TETRYL	0.019	3.88
		RDX	0.206	42.04
		WAX	0.003	0.6
		TRINITROTOLUENE	0.255	54.04
		ANTIMONY SULFIDE	0.000014	0
		NICKEL POWDER	0.000417	0.09

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1330-G890	HAND FRAG MK2/M26 SERIES	POTASSIUM PERCHLORATE	0.0004	0.08
		ZIRCONIUM POWDER	0.000325	0.07
1330-G892	HAND FRAG MK2A1	TRINITROTOLUENE	0.1	100
1330-G911	HAND OFF MK3A2	ANTIMONY SULFIDE	0.000014	0
		BARIUM	0.00172	0.34
		LEAD	0.00073	0.14
		POTASSIUM CHLORATE	0.000027	0.01
		RDX	0.0019	0.38
		ALUMINUM POWDER	0.000006	0
		TRINITROTOLUENE	0.5	99
		ZIRCONIUM POWDER	0.000325	0.06
		POTASSIUM PERCHLORATE	0.0004	0.08
		NICKEL POWDER	0.000417	0.08
1330-G930	HAND SMK HC AN-M8	BARIUM NITRATE	0.000011	0
		ALUMINUM POWDER	0.083	6.97
		LEAD	0.00076	0.06
		POTASSIUM PERCHLORATE	0.000023	0
		POTASSIUM CHLORATE	0.000039	0
		ZIRCONIUM POWDER	0.000043	0
		HEXACHLOROETHANE	0.534	44.9

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1330-G930	HAND SMK HC AN-M8	FERRIC OXIDE	0.000017	0
		ZINC OXIDE	0.57	47.9
		MAGNESIUM POWDER	0.00059	0.05
1330-G935	HAND SMK WP M15	ANTIMONY SULFIDE	0.000014	0
		LEAD	0.000882	0.09
		POTASSIUM CHLORATE	0.000027	0
		RDX	0.00206	0.22
		ZIRCONIUM POWDER	0.000326	0.03
		WHITE PHOSPHOROUS	0.9375	99.38
		BARIUM CHROMATE	0.00171	0.18
		BARIUM NITRATE	0.000013	0
		POTASSIUM PERCHLORATE	0.0004	0.04
		NICKEL POWDER	0.000417	0.04
1330-G940	HAND SMK GRN M18	1,4-DI-P-TOLUIDINOANTHRAQUINON	0.236	32.77
		BENZANTHRONE	0.067	9.3
		DEXTRIN	0.006	0.83
		DIBENZO(B,D&F)CHRYSENE7,14-DI	0.027	3.75
		MAGNESIUM	0.021	2.92
		POTASSIUM CHLORATE	0.23	31.94
		LEAD	0.00076	0.11

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1330-G940	HAND SMK GRN M18	BARIUM	0.000011	0
		LACTOSE	0.129	17.92
		ZIRCONIUM POWDER	0	0
1330-G945	HAND SMK YLW M18	BENZANTHRONE	0.176	24.44
		DEXTRIN	0.02	2.76
		DIBENZO(B,D&F)CHRYSENE7,14-DI	0.08	11.11
		POTASSIUM CHLORATE	0.144	20
		SULFUR	0.061	8.47
		SODIUM BICARBONATE	0.237	32.92
		LEAD	0.00076	0.11
		BARIUM	0.000011	0
		MAGNESIUM POWDER	0	0
		POTASSIUM PERCHLORATE	0.000023	0
1330-G950	HAND SMK RED M18	1-N-METHLAMINO-ANTHRAQUINONE	0.226	31.3
		DEXTRIN	0.039	5.41
		NITROCELLULOSE	0.014	1.94
		POTASSIUM CHLORATE	0.23	31.9
		SULFUR	0.089	12.36
		SODIUM BICARBONATE	0.119	16.5
		LEAD	0.00076	0.11

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1330-G950	HAND SMK RED M18	MAGNESIUM POWDER	0	0
		BARIUM	0.000011	0
		POTASSIUM PERCHLORATE	0.000023	0
1330-G955	HAND SMK VIO M18	1-N-METHLAMINO-ANTHRAQUINONE	0.06	8.29
		1,4-DIAMINO-2,3-DIHYDIANTHRAQU	0.241	33.47
		LEAD	0.00076	0.11
		SULFUR	0.065	9.03
		SODIUM BICARBONATE	0.172	23.88
		POTASSIUM CHLORATE	0.179	24.86
		BARIUM	0.000011	0
		POTASSIUM PERCHLORATE	0.000023	0
		ZIRCONIUM POWDER	0.000043	0
		MAGNESIUM POWDER	0	0
1330-G960	HAND RIOT CN M7 SERIES	BARIUM NITRATE	0.000006	0
		CHLOROACETOPHENONE	0.78	99.6
		TITANIUM	0.000227	0.03
		POTASSIUM CHLORATE	0.000021	0
		GROUND GLASS	0.000006	0
		TRINITROTOLUENE	0.000003	0
		IRON OXIDE	0.000214	0.03

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1330-G960	HAND RIOT CN M7 SERIES	LEAD	0.000193	0.25
		ZIRCONIUM POWDER	0.000073	0.01
		SILICON	0.000616	0.08
1330-G963	HAND RIOT CS M7 SERIES	CS AGENT	0	99.9
		LEAD THIOCYANATE	0	0.1
		LEAD CHROMATE	0	0
1330-G970	RIFLE HEAT M28/M31	LEAD AZIDE	0.000257	0.04
		PETN	0.000357	0.05
		RDX	0.372	58.95
		TETRYL	0.012	1.9
		TRINITROTOLUENE	0.241	38.19
		WAX	0.006	0.95
1337-V172	XM22E8 (HAWK)	AMMONIUM NITRATE	206.7	33.33
		AMMONIUM PERCHLORATE	206.7	33.33
		POTASSIUM CHLORIDE	206.7	33.33
1340-H342	JATO MK25 MOD 1	AMMONIUM NITRATE	122	100
1340-H343	JATO MK7 MOD 2 W/O IGNITER	AMMONIUM PERCHLORATE	117.5	100
1340-H345	JATO MK7 MOD 1 W/O IGNITER	AMMONIUM PERCHLORATE	117.5	100
1340-H555	66MM HEAT M72	CARBON BLACK	0	1.2
		NITROCELLULOSE	0.14	54.6

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1340-H555	66MM HEAT M72	ETHYL CENTRALITE	0	0.9
		NITROGLYCERIN	0	35.5
		POTASSIUM PERCHLORATE	0	7.8
1340-H708	35MM PRAC SUB-CAL M73	CHARCOAL	0	2
		NITROCELLULOSE	0	46
		SULFUR	0	1
		NITROGLYCERIN	0	29
		POTASSIUM PERCHLORATE	0	6
		POTASSIUM NITRATE	0	11
		ETHYL CENTRALITE	0	0.7
		CARBON BLACK	0	0.9
		SILVER	0	1
1340-J106	2.75 IN MK125 SERIES	NITROGLYCERIN	2.95	49
		NITROCELLULOSE	2.95	49
		INERT	0.12	2
1340-J263	RCKT MTR M20A1	CHARCOAL	0.00117	15
		SULFUR	0.00078	10
		POTASSIUM NITRATE	0.00585	75
1345-K002	M1 F/AT MINE PRAC M12A1	CHARCOAL	0.00048	15
		SULFUR	0.000032	10

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1345-K002	M1 F/AT MINE PRAC M12A1	POTASSIUM NITRATE	0.00024	75
1345-K040	SPOTTING F/MINE AP PRAC M8	CHARCOAL	0.00913	15
		SULFUR	0.00608	10
		POTASSIUM NITRATE	0.0456	75
1345-K051	M604 F/AT PRAC MINE M10A1, M12, M20	CHARCOAL	0.000129	0.34
		ALUMINUM	0.00375	9.84
		HEXACHLOROBENZENE	0.00562	14.74
		POTASSIUM NITRATE	0.000304	0.8
		POTASSIUM PERCHLORATE	0.00749	19.65
		ZINC POWDER	0.0206	54.04
		ANTIMONY SULFIDE	0.000039	0.1
		LEAD	0.000069	0.18
		SULFUR	0	0
		POTASSIUM CHLORATE	0.000121	0.32
1345-K058	M605 COMB F/M16 SERIES MINE	CHARCOAL	0.000222	8.88
		LEAD	0.000015	0.62
		POTASSIUM PERCHLORATE	0.000146	5.8
		SULFUR	0.000148	5.92
		POTASSIUM NITRATE	0.00105	42
		POTASSIUM CHLORATE	0.000027	1.08

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1345-K058	M605 COMB F/M16 SERIES MINE	ANTIMONY SULFIDE	0.000009	0.34
		BARIUM CHROMATE	0.000625	25
		NICKEL ALLOY	0.000153	6.12
		ZIRCONIUM	0.000118	4.72
1345-K090	AP M2 SERIES	CHARCOAL	0.00115	0.3
		LEAD AZIDE	0.000583	0.15
		TETRYL	0.0356	9.27
		POTASSIUM NITRATE	0.00577	1.5
		SULFUR	0.00077	0.2
		TRINITROTOLUENE	0.34	88.56
1345-K092	APER M16 SERIES BOUNDING	CHARCOAL	0.000223	0.02
		BARIUM CHROMATE	0.000626	0.05
		POTASSIUM PERCHLORATE	0.000146	0.01
		POTASSIUM NITRATE	0.00105	0.08
		SULFUR	0.000148	0.01
		TRINITROTOLUENE	1.3	99.8
		LEAD	0.000016	0
		ZIRCONIUM	0.000118	0.09
		NICKEL ALLOY	0.000153	0.01
		POTASSIUM CHLORATE	0.000027	0

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1345-K120	AP M3	TRINITROTOLUENE	0.9	100
1345-K121	APERS M14	TETRYL	0.0625	100
1345-K143	APERS M18A1 W/M57 FIRING DEVICE	BARIUM CHROMATE	0.000139	0.01
		LEAD	0.00212	0.15
		PETN	0.000771	0.05
		RDX	1.4308	99.79
1345-K145	APERS M18A1 W/O FIRING DEVICE	RDX	1.43	100
1345-K146	APERS M26 BOUNDING	RDX	0	60
		TRINITROTOLUENE	0	39
		WAX	0	1
1345-K180	AT HEAVY M15	ANTIMONY SULFIDE	0.000044	0
		LEAD	0.000683	0
		RDX	13.68	60
		TETRYL	0.0051	0.02
		TRINITROTOLUENE	8.89	37.75
		WAX	0.228	0.1
		POTASSIUM CHLORATE	0.00014	0
1345-K181	AT HEAVY M21	ALUMINUM POWDER	2.16	19.9
		LEAD AZIDE	0.00128	0.01
		NITROCELLULOSE	0.0756	0.7

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1345-K181	AT HEAVY M21	RDX	4.89	45.15
		TRINITROTOLUENE	3.24	29.9
		WAX	0.432	3.99
		CALCIUM CHLORIDE	0.0324	0.3
		LECITHIN	0.0108	0.1
1345-K250	AT HEAVY M19 NON-METALLIC	ANTIMONY SULFIDE	0.00004	0
		LEAD	0.000608	0
		RDX	12.72	60.22
		POTASSIUM CHLORATE	0.000123	0
		TRINITROTOLUENE	8.19	38.78
		WAX	0.21	0.99
1346-K001	AT MINE M2	CHARCOAL	0.000048	15
		SULFUR	0.000032	10
		POTASSIUM NITRATE	0.00024	75
1365-K515	CN	CN AGENT	0.0022	100
1365-K531	XM32	CS AGENT	65	100
1365-K765	CS	CS AGENT	0.0044	40
		NITROCELLULOSE	0.00033	3
		MAGNESIUM CARBONATE	0.00132	12
		SUGAR	0.00198	18

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1365-K765	CS	POTASSIUM CHLORATE	0.00297	27
1365-K768	CS-1	CS AGENT	8	100
1365-K865	M1 HC (5-8 MIN BURN)	ALUMINUM POWDER	0.6	6
		HEXACHLOROETHANE	4.6	46
		ZINC OXIDE	4.8	48
1365-K887	SMOKE POT M207A1 MECH	BARIUM NITRATE	0.000006	0.19
		IRON OXIDE	0.000214	6.99
		SILICON	0.000616	20.13
		TITANIUM	0.000213	6.96
		LEAD	0.00189	61.76
		ZIRCONIUM POWDER	0.000073	2.38
		LEAD THIOCYANATE	0.000021	0.7
		GROUND GLASS	0.000006	0.19
		TRINITROTOLUENE	0.000003	0.09
		POTASSIUM CHLORATE	0.000021	0.7
1370-L130	PERC F/DISCHARGER SMK PUFF	BARIUM NITRATE	0.00006	20
		ANTIMONY SULFIDE	0.000045	15
		LEAD	0.00018	60
		TETRACENE	0.000015	5
1370-L377	DETONATION EXPL MK2 MOD 0	CHARCOAL	0.00198	15

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1370-L377	DETONATION EXPL MK2 MOD 0	SULFUR	0.00132	10
		POTASSIUM NITRATE	0.0099	75
1370-L495	SURF TRIP PARA YLW M49 SERIES	BARIUM CHROMATE	0.0117	3.7
		MAGNESIUM POWDER	0.141	44.48
		BORON	0.00131	0.41
		LAMANIC	0.0209	6.59
		SODIUM NITRATE	0.138	43.53
		BARIUM NITRATE	0.000001	0
		COBALT NAPHTHANATE	0.000237	0.07
		VINYL ALCOHOL ACETATE RESIN	0.00315	0.99
		LEAD STYPHNATE	0.000027	0
		LUPERSOL	0.000237	0.07
1370-L594	PROJ GRND BURST M115A1	ALUMINUM POWDER	0.0406	25.37
		MAGNESIUM	0.053	33.12
		RED GUM	0.000131	0.08
		POTASSIUM PERCHLORATE	0.0654	40.87
		SODIUM SALCYLATE	0.00123	0.77
1370-L596	FLASH ARTY M110	DIAZODINITROPHENOL	0	19.7
		CHARCOAL	0	15.06
		NITROSTARCH	0	4.9

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1370-L596	FLASH ARTY M110	SULFUR	0	0.17
		POTASSIUM NITRATE	0	1.24
		POTASSIUM CHLORATE	0	59
1375-M023	DEMO BLOCK M112 1 1/4 LB COMP C-4	RDX	34.1	91
		TEFLON	3.38	9
1375-M024	DEMO BLOCK M118 2 LB PETN	RDX	40	100
1375-M026	BANGALORE TORP M1A1	AMATOL	81	90
		TRINITROTOLUENE	9	10
1375-M028	BANGALORE TORP M1A2	RDX	110	61
		RDX	0	0.4
		TRINITROTOLUENE	0	38
1375-M030	DEMO BLOCK TNT 1/4 LB	TRINITROTOLUENE	0.25	100
1375-M031	DEMO BLOCK TNT 1/2 LB	TRINITROTOLUENE	0.5	100
1375-M032	DEMO BLOCK TNT 1 LB	TRINITROTOLUENE	1	100
1375-M034	DEMO BLOCK TNT 8 LB	TRINITROTOLUENE	8	100
1375-M035	DEMO CHAIN M1 8 X 2 1/2 LB	TETRYL	15.09	75
		TRINITROTOLUENE	5.03	25
1375-M039	DEMO BLOCK 40 LB CRATERING	AMMONIUM NITRATE	30	75
		TRINITROTOLUENE	10	25
1375-M060	DEMO ROLL M186 25 LB COMP H-6	ALUMINUM POWDER	5	20

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1375-M060	DEMO ROLL M186 25 LB COMP H-6	CALCIUM CHLORIDE	0.075	0.3
		NITROCELLULOSE	0.175	0.7
		RDX	11.3	45
		TRINITROTOLUENE	7.5	30
		LECITHIN	0.025	0.1
		WAX	1	4
1375-M120	BLASTING ELEC NO 8	LEAD AZIDE	0	50
		RDX	0	50
1375-M121		LEAD AZIDE	0	50
		PETN	0	50
1375-M130	BLASTING ELEC M6	LEAD AZIDE	0	50
		PETN	0	50
1375-M131	BLASTING NON-ELEC M7	LEAD AZIDE	0	50
		PETN	0	50
1375-M327	FIRING DEVICE W/PRIMER	BARIUM NITRATE	0.000005	8.7
		GROUND GLASS	0.000006	10.5
		LEAD THIOCYANATE	0.000022	38
		POTASSIUM CHLORATE	0.000021	37
		TRINITROTOLUENE	0.000003	5.8
1375-M420	DEMO SHAPED M2 SERIES 15 LB	RDX	6.6	60

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1375-M420	DEMO SHAPED M2 SERIES 15 LB	TRINITROTOLUENE	4.29	39
		WAX	0.11	1
1375-M421	DEMO SHAPED M3 SERIES 40 LB	CELLULOSE	0.01	0.02
		LEAD AZIDE	0.001	0.01
		PETN	1.25	3.07
		RDX	27.5	67.55
		TRINITROTOLUENE	11.95	29.35
1375-M445	PROJ CHG AP M1/M1A1	PETN	46	100
1375-M448	PERC M2A1 8 SEC DELAY	ANTIMONY	0	50
		POTASSIUM PERMANGANATE	0	50
1375-M450	PERC M1A2	ANTIMONY	0	50
		POTASSIUM PERMANGANATE	0	50
1375-M455	DET PETN	PETN	0	100
1375-M456	DET PETN TYP 1 CL E (NEW-1000 FT)	PETN	2.48	100
1375-M540	CONCUSSION M1	BARIUM NITRATE	0	0.2
		LEAD AZIDE	0	19
		LEAD STYPHNATE	0	3
		LEAD THIOCYANATE	0	0.8
		RDX	0	76
		POTASSIUM CHLORATE	0	0.8

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1375-M540	CONCUSSION M1	GLASS	0	0.2
		TRINITROTOLUENE	0	0.1
1375-M591	DYNAMITE MILITARY M1	MOTOR OIL	0	4
		RDX	0.5	75
		STARCH	0	5
		POLYISOBUTYLENE	0	1
		TRINITROTOLUENE	0	15
1375-M610	FILE INCD M4	CALCIUM PHOSPHATE	0.00659	0.4
		CHARCOAL	0.000043	0
		DIAZODINITROPHENOL	0.000057	0
		NITROSTARCH	0.000014	0
		POTASSIUM CHLORATE	0.000171	0.01
		SODIUM NITRATE	1.64	99.58
		ACETONE	0	0
1375-M611		CALCIUM PHOSPHATE	0.00659	0.4
		DIAZODINITROPHENOL	0.000057	0
		CHARCOAL	0.000043	0
		NITROSTARCH	0.000014	0
		SODIUM NITRATE	1.64	99.58
		POTASSIUM CHLORATE	0.000171	0.01

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1375-M611	FILE INCD M4	ACETONE	0	0
1375-M616	DEMO M1 6-14 MIN DELAY	BARIUM NITRATE	0	8.7
		LEAD THIOCYANATE	0	38
		GLASS	0	10.5
		POTASSIUM CHLORATE	0	37
		TRINITROTOLUENE	0	5.8
1375-M626	DEMO PRESSURE M1	BARIUM NITRATE	0.000005	8.7
		GROUND GLASS	0.000006	10.5
		LEAD THIOCYANATE	0.000022	38
		POTASSIUM CHLORATE	0.000021	37
		TRINITROTOLUENE	0.000003	5.8
1375-M627	DEMO PRESSURE RELEASE M	BARIUM NITRATE	0.000005	8.7
		LEAD THIOCYANATE	0.000022	38
		GROUND GLASS	0.000006	10.5
		POTASSIUM CHLORATE	0.000021	37
		TRINITROTOLUENE	0.000003	5.8
1375-M629	DEMO PULL RELEASE M3	BARIUM NITRATE	0	8.7
		GLASS	0	10
		LEAD THIOCYANATE	0	38
		POTASSIUM CHLORATE	0	37

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1375-M629	DEMO PULL RELEASE M3	TRINITROTOLUENE	0	0
1375-M630	DEMO PULL M1	BARIUM NITRATE	0.000005	8.7
		GROUND GLASS	0.000006	10.5
		LEAD THIOCYANATE	0.000022	38
		POTASSIUM CHLORATE	0.000021	37
		TRINITROTOLUENE	0.000003	5.8
1375-M670	BLASTING TIME M700	CHARCOAL	0	15.6
		POTASSIUM NITRATE	0	74
		SULFUR	0	10.4
1375-M756	DEMO CHAIN M37 SERIES	MOTOR OIL	0.32	1.6
		RDX	18.24	91
		SEBACATE	1.06	5.3
		POLYISOBUTYLENE	0.42	2.1
1375-M757	ASSY DEMO M183 COMP C-4 8 X 2 1/2 LB	FUEL OIL #6	0.32	1.6
		RDX	18.27	91
		POLYISOBUTYLENE	0.42	2.1
		SEBACATE	1.06	5.3
1375-M766	M2/M60 F/TIME BLASTING FUSE	ANTIMONY SULFIDE	0	8.3
		CALCIUM SILICIDE	0	8.3
		BARIUM NITRATE	0	8.3

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1375-M766	M2/M60 F/TIME BLASTING FUSE	LEAD STYPHNATE	0	8.3
		POTASSIUM CHLORATE	0	8.3
		TETRACENE	0	8.3
		CHARCOAL	0	8.3
		GUM ARABIC	0	8.3
		POTASSIUM NITRATE	0	8.3
		TRINITROTOLUENE	0	8.3
1375-M810	PERC M2/M3	BARIUM NITRATE	0	8.3
		CALCIUM SILICIDE	0	8.3
		ANTIMONY SULFIDE	0	8.3
		LEAD STYPHNATE	0	8.3
		POTASSIUM CHLORATE	0	8.3
		TETRACENE	0	8.3
		GUM ARABIC	0	8.3
		CHARCOAL	0	8.3
		TRINITROTOLUENE	0	8.3
		POTASSIUM NITRATE	0	8.3
1375-M965	CHG DEMO CRATERING M180	ALUMINUM POWDER	0	14.8
		NITROCELLULOSE	0	4.8
		RDX	0	43.6

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1375-M965	CHG DEMO CRATERING M180	NITROGLYCERIN	0	3.1
		POTASSIUM PERCHLORATE	0	0.7
		CALCIUM CHLORIDE	0	3.5
		BARIUM POTASSIUM NITRATE	0	1
		TRINITROTOLUENE	0	28
		WAX	0	0.2
	DEMO CRATERING M180	AMMONIUM NITRATE	38.334	75
		TRINITROTOLUENE	12.778	25
1375-ML03	DEMO MULTI-PURPOSE M142	ANTIMONY SULFIDE	0	17
		LEAD AZIDE	0	5.6
		LEAD THIOCYANATE	0	25
		POTASSIUM CHLORATE	0	53
1375-ML15	DEMO FLEX LINEAR SHAPED 225 GR/FT	CALCIUM STEARATE	0.000483	1.5
		GRAPHITE	0.000161	0.5
		POLYISOBUTYLENE	0.000161	0.5
		RDX	0.0313	97.5
1375-ML16	DEMO FLEX LINEAR SHAPED 300 GR/FT	CALCIUM STEARATE	0.000643	1.5
		GRAPHITE	0.000214	0.5
		RDX	0.0418	97.5
		POLYISOBUTYLENE	0.000214	0.5

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1375-ML17	DEMO FLEX LINEAR SHAPED 400 GR/FT	CALCIUM STEARATE	0.000857	1.5
		GRAPHITE	0.000286	0.5
		RDX	0.0557	97.5
		POLYISOBUTYLENE	0.000286	0.5
1375-ML18	DEMO FLEX LINEAR SHAPED 500 GR/FT	CALCIUM STEARATE	0.00107	1.5
		GRAPHITE	0.000357	0.5
		POLYISOBUTYLENE	0.000357	0.5
		RDX	0.0696	97.5
1375-ML19	DEMO FLEX LINEAR SHAPED 600 GR/FT	CALCIUM STEARATE	0.00129	1.5
		GRAPHITE	0.000429	0.5
		POLYISOBUTYLENE	0.000429	0.5
		RDX	0.0836	97.5
1375-MW84	DEMO TUBULAR MK75	PETN	50	100
1377-M500	CTG ACT M21 F/REEFING LINE	DIPHENYLAMINE	0	50
		NITROCELLULOSE	0	50
1377-M842	ELEC M1	DIAZODINITROPHENOL	0.000029	20
		CHARCOAL	0.000021	15
		NITROSTARCH	0.000007	5
		POTASSIUM CHLORATE	0	60
1377-M851	ELEC M1A1	CHARCOAL	0.000021	15

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1377-M851	ELEC M1A1	DIAZODINITROPHENOL	0.000029	20
		NITROSTARCH	0.000007	5
		POTASSIUM CHLORATE	0.000086	60
1390-N248	MT M565 W/O BOOSTER	ANTIMONY SULFIDE	0	1.28
		BARIUM NITRATE	0	1.54
		LEAD AZIDE	0	80.81
		LEAD STYPHNATE	0	3.06
		TETRACENE	0	0.5
		RDX	0	12.79
1390-N334	PD M567 DELAY W/O BOOSTER	BARIUM	0.000369	3.65
		LEAD	0.000516	5.11
		RDX	0.009	89.06
		ZIRCONIUM POWDER	0.000221	2.19
1390-N335	PD M557 DELAY W/BOOSTER NON-PROP PKG	ANTIMONY SULFIDE	0	0.11
		BARIUM NITRATE	0	0.02
		LEAD AZIDE	0	2.32
		LEAD STYPHNATE	0	0.03
		POTASSIUM CHLORATE	0	0.1
		TETRACENE	0	0
		BORON POWDER	0	0.02

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1390-N335	PD M557 DELAY W/BOOSTER NON-PROP PKG	BARIUM CHROMATE	0	0.12
		CARBORUNDUM	0	0.01
		TETRYL	0	97.26
1390-N340	PD M739 00-574-7705	BARIUM CHROMATE	0.000047	0.1
		BORON POWDER	0.000009	0.02
		BARIUM NITRATE	0.000043	0.09
		LEAD STYPHNATE	0.000086	0.18
		LEAD AZIDE	0.000771	1.62
		VINYL ALCOHOL ACETATE RESIN	0	0
		ANTIMONY SULFIDE	0.000032	0.07
		WAX	0.000697	1.47
		TETRACENE	0.000011	0.02
		RDX	0.0458	96.42
1390-N402	PROX M532 WRBND BX	ANTIMONY SULFIDE	0.000007	2.15
		BARIUM NITRATE	0.000009	2.58
		LEAD AZIDE	0.000237	71.82
		LEAD STYPHNATE	0.000017	5.18
		RDX	0.000057	17.3
		TETRACENE	0.000003	0.85
1390-N518	PERC M28	BARIUM NITRATE	0.00006	20

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1390-N518	PERC M28	ANTIMONY SULFIDE	0.000045	15
		LEAD	0.00018	60
		TETRACENE	0.000015	5
1390-N519	PERC M57	ANTIMONY SULFIDE	0.000024	0.26
		CHARCOAL	0.00145	15.38
		SULFUR	0.000966	10.24
		POTASSIUM CHLORATE	0.000076	0.8
		POTASSIUM NITRATE	0.00687	72.85
		LEAD THIOCYANATE	0.000036	0.38
		TRINITROTOLUENE	0.000007	0.08
1390-N523	PERC M82	CHARCOAL	0.00049	15.22
		BARIUM NITRATE	0.000027	0.84
		LEAD STYPHNATE	0.000031	0.98
		TETRACENE	0.000003	0.01
		POTASSIUM NITRATE	0.00232	72.05
		SULFUR	0.000327	10.15
		ANTIMONY SULFIDE	0.000013	0.4
		ALUMINUM POWDER	0.000006	0.18
		PENTAERYTHRITOL	0.000004	0.13
1390-N525	PERC MK2A4	CHARCOAL	0.000423	15.11

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
1390-N525	PERC MK2A4	BARIUM NITRATE	0.000027	0.97
		LEAD STYPHNATE	0.000031	1.12
		TETRACENE	0.000003	0.1
		POTASSIUM NITRATE	0.00201	71.79
		SULFUR	0.000283	10.11
		ALUMINUM POWDER	0.000006	0.2
		ANTIMONY SULFIDE	0.000013	0.46
		PENTAERYTHRITOL	0.000004	0.15
1390-N538	ELEC MK49 MOD 4	CHARCOAL	0.00891	15.6
		SULFUR	0.00594	10.4
		POTASSIUM NITRATE	0.0423	74
1410-PB18	SURF ATTACK PRAC BTM-71-A STD RANGE (TOW)	RDX	6.9	100
3427-PL22	W/LNCHR SURF ATTACK PRAC M223 (DRAGON)	2-NITROPHENYLAMINE	0	1
		CANDELILLA WAX	0	0.1
		NITROGLYCERIN	0	36.2
		NITROCELLULOSE	0	50
		LEAD SALICYLATE	0	1.5
		TRIACETIN	0.71	9.7
		LEAD-2-ETHYLHEXOLATE	0	1.5
3427-PL23	W/LNCHR SURF ATTACK M222 (DRAGON)	2-NITROPHENYLAMINE	0	0.2

SUMMARY OF ITEMS WITH THEIR CHEMICAL COMPOSITION

DODAC_NO	ITEM	ENERGETIC CONSTITUENT	WEIGHT (lb)	WEIGHT PERCENT
3427-PL23	W/LNCHR SURF ATTACK M222 (DRAGON)	LEAD SALICYLATE	0	0.2
		NITROCELLULOSE	4.26	8
		LEAD-2-ETHYLHEXOLATE	0	0.2
		NITROGLYCERIN	0	6
		TRIACETIN	0	0.2
		OCTOL	0	83

APPENDIX C-3

AVERAGE AND RANGE OF WEIGHT COMPOSITION BY CONSTITUENT (SUMMARIZED BY FAMILY)

CLASS SUMMARY FOR CLASS: 1a

	MAX WEIGHT %	AVG WEIGHT %
ALUMINUM POWDER	0.400	0.253
ANTIMONY SULFIDE	1.000	0.507
BARIUM	4.870	4.185
BARIUM NITRATE	5.310	1.854
CALCIUM CARBONATE	0.910	0.553
CALCIUM RESINATE	0.410	0.360
CALCIUM SILICIDE	1.000	0.660
CHARCOAL	15.000	15.000
CHLORINATED RUBBER	0.790	0.790
DIBUTYLPHTHALATE	8.960	3.793
DINITROTOLUENE	9.350	3.347
DIPHENYLAMINE	1.330	0.978
ETHYL CENTRALITE	2.400	1.627
ETHYLENE DIMETHYLACRYLATE	3.000	3.000
GRAPHITE	0.540	0.420
LEAD STYPHNATE	4.640	1.413
MAGNESIUM POWDER	5.250	3.505
MAGNESIUM/ALUMINUM ALLOY	2.750	2.750
NITROCELLULOSE	87.170	74.616
NITROGLYCERIN	37.260	15.633
PETN	0.300	0.223
POLYVINYL CHLORIDE	2.220	2.173
POTASSIUM	1.230	1.230
POTASSIUM NITRATE	75.000	15.600
POTASSIUM SULFATE	1.650	1.082
SODIUM SULFATE	0.460	0.333
SODIUM SULFIDE	0.490	0.490
STRONTIUM	10.020	7.007
STRONTIUM NITRATE	7.200	7.200
STRONTIUM PEROXIDE	1.700	1.700
SULFUR	10.000	10.000
TETRACENE	0.330	0.225

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 1b

	MAX WEIGHT %	AVG WEIGHT %
ALUMINUM	9.840	9.840
ALUMINUM POWDER	0.120	0.120
ANTIMONY SULFIDE	2.150	0.596
BARIUM	3.650	2.925
BARIUM CHROMATE	25.000	5.066
BARIUM NITRATE	2.580	0.758
BORON POWDER	0.020	0.020
CALCIUM STEARATE	0.120	0.120
CARBORUNDUM	0.010	0.010
CHARCOAL	15.600	10.964
FERRIC OXIDE	0.390	0.390
GROUND GLASS	0.190	0.190
HEXACHLOROBENZENE	14.740	14.740
IRON OXIDE	6.990	5.765
LEAD	61.760	23.079
LEAD AZIDE	80.810	26.203
LEAD STYPHNATE	5.180	2.113
LEAD THIOCYANATE	0.700	0.700
MAGNESIUM POWDER	13.630	13.630
NICKEL ALLOY	6.120	6.120
NICKEL POWDER	0.490	0.490
PETN	100.000	100.000
POTASSIUM CHLORATE	1.080	0.530
POTASSIUM NITRATE	75.000	53.360
POTASSIUM PERCHLORATE	19.650	4.358
RAREOX	0.020	0.010
RDX	100.000	71.748
SILICON	20.130	16.885
SULFUR	10.400	7.264
TETRACENE	0.850	0.286
TETRYL	99.850	49.413
TITANIUM	6.960	6.960
TRINITROTOLUENE	0.090	0.075
VINYL ALCOHOL ACETATE RESIN	0.000	0.000

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 1b

	MAX WEIGHT %	AVG WEIGHT %
WAX	1.490	1.480
ZINC POWDER	54.040	54.040
ZIRCONIUM	4.720	4.720
ZIRCONIUM POWDER	2.380	1.112

* Percentile (based on weight per item) averaged over all items in class identified.

CLASS SUMMARY FOR CLASS: 1c

	MAX WEIGHT %	AVG WEIGHT %
ALUMINUM POWDER	25.370	8.583
AMMONIUM NITRATE	75.000	75.000
ANTIMONY	50.000	50.000
ANTIMONY SULFIDE	17.000	8.090
BARIUM NITRATE	20.000	9.218
CALCIUM SILICIDE	8.300	8.300
CHARCOAL	15.600	13.791
DIAZODINITROPHENOL	20.000	20.000
DINITROCELLULOSE	7.000	7.000
DIPHENYLAMINE	50.000	25.450
ETHYL CENTRALITE	0.800	0.775
GLASS	10.500	10.250
GRAPHITE	0.200	0.200
GROUND GLASS	10.500	10.500
GUM ARABIC	8.300	8.300
LEAD	60.000	60.000
LEAD AZIDE	50.000	41.120
LEAD STYPHNATE	8.300	4.675
LEAD THIOCYANATE	38.000	31.673
MAGNESIUM	33.120	33.120
NITROCELLULOSE	91.400	64.238
NITROGLYCERIN	40.000	40.000
NITROSTARCH	5.000	5.000
PENTAERYTHRITOL	0.150	0.140
PETN	50.000	50.000
POTASSIUM CHLORATE	60.000	34.367
POTASSIUM NITRATE	75.000	46.029
POTASSIUM PERCHLORATE	40.870	40.870
POTASSIUM PERMANGANATE	50.000	50.000
POTASSIUM SULFATE	0.600	0.600
RDX	60.000	56.667
RED GUM	0.080	0.080
SODIUM SALCYLATE	0.770	0.770
SULFUR	10.400	10.150

*** Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 1c

	MAX WEIGHT %	AVG WEIGHT %
TETRACENE	8.300	4.452
TETRYL	75.000	75.000
TRINITROTOLUENE	39.000	14.912
WAX	1.000	1.000

* Percentile (based on weight per item) averaged over all items in class identified.

CLASS SUMMARY FOR CLASSES 1A-1C COMBINED

	MAX WEIGHT %	AVG WEIGHT %
ALUMINUM	9.840	0.141
ALUMINUM POWDER	25.370	0.384
AMMONIUM NITRATE	75.000	1.071
ANTIMONY	50.000	1.429
ANTIMONY SULFIDE	17.000	1.071
BARIUM	4.870	0.203
BARIUM CHROMATE	25.000	0.362
BARIUM NITRATE	20.000	1.989
BORON POWDER	0.020	0.001
CALCIUM CARBONATE	0.910	0.032
CALCIUM RESINATE	0.410	0.010
CALCIUM SILICIDE	8.300	0.275
CALCIUM STEARATE	0.120	0.002
CARBORUNDUM	0.010	0.000
CHARCOAL	15.600	2.968
CHLORINATED RUBBER	0.790	0.011
DIAZODINITROPHENOL	20.000	0.571
DIBUTYLPHTHALATE	8.960	0.433
DINITROCELLULOSE	7.000	0.100
DINITROTOLUENE	9.350	0.526
DIPHENYLAMINE	50.000	0.923
ETHYL CENTRALITE	2.400	0.162
ETHYLENE DIMETHYLACRYLATE	3.000	0.043
FERRIC OXIDE	0.390	0.006
GLASS	10.500	0.293
GRAPHITE	0.540	0.021
GROUND GLASS	10.500	0.603
GUM ARABIC	8.300	0.237
HEXACHLOROBENZENE	14.740	0.211
IRON OXIDE	6.990	0.165

*** Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASSES 1A-1C COMBINED

	MAX WEIGHT %	AVG WEIGHT %
LEAD	61.760	4.022
LEAD AZIDE	80.810	5.183
LEAD STYPHNATE	8.300	0.711
LEAD THIOCYANATE	38.000	3.630
MAGNESIUM	33.120	0.473
MAGNESIUM POWDER	13.630	0.395
MAGNESIUM/ALUMINUM ALLOY	2.750	0.039
NICKEL ALLOY	6.120	0.087
NICKEL POWDER	0.490	0.007
NITROCELLULOSE	91.400	21.792
NITROGLYCERIN	40.000	4.269
NITROSTARCH	5.000	0.143
PENTAERYTHRITOL	0.150	0.004
PETN	100.000	3.581
POLYVINYL CHLORIDE	2.220	0.093
POTASSIUM	1.230	0.018
POTASSIUM CHLORATE	60.000	5.929
POTASSIUM NITRATE	75.000	11.501
POTASSIUM PERCHLORATE	40.870	0.957
POTASSIUM PERMANGANATE	50.000	1.429
POTASSIUM SULFATE	1.650	0.101
RAREOX	0.020	0.000
RDX	100.000	10.628
RED GUM	0.080	0.001
SILICON	20.130	0.482
SODIUM SALCYLATE	0.770	0.011
SODIUM SULFATE	0.460	0.014
SODIUM SULFIDE	0.490	0.007
STRONTIUM	10.020	0.300
STRONTIUM NITRATE	7.200	0.103

*** Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASSES 1A-1C COMBINED

	MAX WEIGHT %	AVG WEIGHT %
STRONTIUM PEROXIDE	1.700	0.024
SULFUR	10.400	1.532
TETRACENE	8.300	0.421
TETRYL	99.850	6.038
TITANIUM	6.960	0.099
TRINITROTOLUENE	39.000	3.198
VINYL ALCOHOL ACETATE RESIN	0.000	0.000
WAX	1.490	0.071
ZINC POWDER	54.040	0.772
ZIRCONIUM	4.720	0.067
ZIRCONIUM POWDER	2.380	0.095

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASSES 1B-1C COMBINED

	MAX WEIGHT %	AVG WEIGHT %
ALUMINUM	9.840	0.186
ALUMINUM POWDER	25.370	0.488
AMMONIUM NITRATE	75.000	1.415
ANTIMONY	50.000	1.887
ANTIMONY SULFIDE	17.000	1.300
BARIUM	3.650	0.110
BARIUM CHROMATE	25.000	0.478
BARIUM NITRATE	20.000	2.173
BORON POWDER	0.020	0.001
CALCIUM SILICIDE	8.300	0.313
CALCIUM STEARATE	0.120	0.002
CARBORUNDUM	0.010	0.000
CHARCOAL	15.600	3.636
DIAZODINITROPHENOL	20.000	0.755
DINITROCELLULOSE	7.000	0.132
DIPHENYLAMINE	50.000	0.960
ETHYL CENTRALITE	0.800	0.029
FERRIC OXIDE	0.390	0.007
GLASS	10.500	0.387
GRAPHITE	0.200	0.004
GROUND GLASS	10.500	0.796
GUM ARABIC	8.300	0.313
HEXACHLOROBENZENE	14.740	0.278
IRON OXIDE	6.990	0.218
LEAD	61.760	5.312
LEAD AZIDE	80.810	6.846
LEAD STYPHNATE	8.300	0.512
LEAD THIOCYANATE	38.000	4.794
MAGNESIUM	33.120	0.625

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASSES 1B-1C COMBINED

	MAX WEIGHT %	AVG WEIGHT %
MAGNESIUM POWDER	13.630	0.257
NICKEL ALLOY	6.120	0.115
NICKEL POWDER	0.490	0.009
NITROCELLULOSE	91.400	4.848
NITROGLYCERIN	40.000	1.509
NITROSTARCH	5.000	0.189
PENTAERYTHRITOL	0.150	0.005
PETN	100.000	4.717
POTASSIUM CHLORATE	60.000	7.831
POTASSIUM NITRATE	75.000	13.719
POTASSIUM PERCHLORATE	40.870	1.265
POTASSIUM PERMANGANATE	50.000	1.887
POTASSIUM SULFATE	0.600	0.011
RAREOX	0.020	0.000
RDX	100.000	14.037
RED GUM	0.080	0.002
SILICON	20.130	0.637
SODIUM SALCYLATE	0.770	0.015
SULFUR	10.400	1.834
TETRACENE	8.300	0.531
TETRYL	99.850	7.975
TITANIUM	6.960	0.131
TRINITROTOLUENE	39.000	4.223
VINYL ALCOHOL ACETATE RESIN	0.000	0.000
WAX	1.490	0.094
ZINC POWDER	54.040	1.020
ZIRCONIUM	4.720	0.089
ZIRCONIUM POWDER	2.380	0.126

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 2

	MAX WEIGHT %	AVG WEIGHT %
1,4-DI-P-TOLUIDINOANTHRAQUINON	32.770	26.797
1,4-DIAMINO-2,3-DIHYDIANTHRAQU	33.470	33.470
1-N-METHLAMINO-ANTHRAQUINONE	42.120	25.645
2-(2'-QUINOLYL)-1,3-INDANDIONE	40.410	26.230
2-NITROPHENYLAMINE	0.910	0.910
ALUMINUM	5.000	5.000
ALUMINUM POWDER	6.970	4.743
ANTIMONY SULFIDE	0.010	0.002
ASBESTOS	1.600	1.600
BARIUM	0.000	0.000
BARIUM CHROMATE	1.370	0.858
BARIUM NITRATE	0.020	0.005
BENZANTHRONE	24.440	16.870
BORON POWDER	0.550	0.550
BUTYL RUBBER	4.770	4.770
CALCIUM SILICIDE	0.000	0.000
CARBORUNDUM	0.000	0.000
CHARCOAL	15.000	1.556
CHROMIC ACID	0.910	0.910
CHROMIC OXIDE	0.910	0.910
CRYOLITE	0.180	0.180
DEXTRIN	36.790	11.448
DIBENZO(B,D&F)CHRYSENE7,14-DI	11.110	7.430
DIBUTYLPHTHALATE	4.000	2.822
DIETHYLPHTHALATE	0.200	0.200
DINITROCELLULOSE	7.000	7.000
DINITROTOLUENE	10.000	7.314
DIPHENYLAMINE	1.000	0.798
ETHYL CENTRALITE	0.000	0.000
FERRIC NITRATE	0.000	0.000
FERRIC OXIDE	0.000	0.000
GRAPHITE	0.200	0.113
HEXACHLOROETHANE	46.000	42.300
INERT	15.700	15.700

* Percentile (based on weight per item) averaged over all items in class identified.

CLASS SUMMARY FOR CLASS: 2

	MAX WEIGHT %	AVG WEIGHT %
LACTOSE	17.920	17.920
LEAD	1.650	0.166
LEAD AZIDE	0.060	0.043
LEAD THIOCYANATE	0.000	0.000
MAGNESIUM	2.920	2.920
MAGNESIUM CARBONATE	20.220	18.300
MAGNESIUM POWDER	0.120	0.034
NICKEL POWDER	0.040	0.040
NITROCELLULOSE	91.400	41.728
NITROGLYCERIN	11.530	2.520
NITROGUANIDINE	33.190	33.190
NITROTOLUENE	85.000	85.000
POTASSIUM	1.350	0.624
POTASSIUM CHLORATE	31.940	17.545
POTASSIUM NITRATE	75.000	7.070
POTASSIUM PERCHLORATE	0.190	0.076
POTASSIUM SULFATE	2.770	1.685
RDX	1.360	0.754
RED PHOSPHOROUS	90.630	90.630
SODIUM BICARBONATE	32.920	17.910
STRONTIUM NITRATE	0.120	0.120
SULFUR	12.360	4.468
TETRYL	3.350	1.533
TETRYTOL	1.750	1.750
TRINITROTOLUENE	0.900	0.388
VINYL ALCOHOL ACETATE RESIN	1.950	1.950
WHITE PHOSPHOROUS	99.380	57.688
YELLOW DYE	54.560	54.560
YELLOW SMOKE B-10	6.700	6.700
ZINC OXIDE	48.000	44.575
ZIRCONIUM POWDER	0.030	0.008

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 3

	MAX WEIGHT %	AVG WEIGHT %
ACETONE	0.000	0.000
ALUMINUM POWDER	13.750	13.750
ANTIMONY SULFIDE	0.000	0.000
ASPHALTOM	4.910	4.910
BARIUM CHROMATE	3.700	3.700
BARIUM NITRATE	41.300	20.645
BINDER	3.240	3.240
BORON	0.410	0.410
CALCIUM PHOSPHATE	0.400	0.400
CHARCOAL	15.060	2.732
COBALT NAPHTHANATE	0.070	0.070
DEXTRIN	0.020	0.020
DIAZODINITROPHENOL	19.700	6.567
DIBUTYLPHTHALATE	2.930	2.930
DIETHYLPHTHALATE	0.420	0.420
DINITROTOLUENE	9.860	9.860
DIPHENYLAMINE	0.590	0.590
FIRST FIRE	6.500	6.500
FUEL OIL #6	7.860	7.860
HEXACHLOROBENZENE	0.030	0.030
LAMANIC	91.020	48.805
LEAD	0.030	0.015
LEAD AZIDE	0.000	0.000
LEAD STYPHNATE	0.000	0.000
LEAD THIOCYANATE	0.010	0.010
LINSEED OIL	2.950	1.480
LUPERSOL	0.070	0.070
MAGNESIUM	44.860	44.860
MAGNESIUM POWDER	44.480	23.484
NITROCELLULOSE	83.850	23.385
NITROGLYCERIN	6.190	3.165
NITROSTARCH	4.900	1.633
POTASSIUM CHLORATE	59.000	12.464
POTASSIUM NITRATE	2.350	1.278

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 3

	MAX WEIGHT %	AVG WEIGHT %
POTASSIUM PERCHLORATE	0.040	0.040
SODIUM NITRATE	99.580	57.802
SODIUM OXALATE	0.050	0.050
STRONTIUM NITRATE	10.820	7.217
SULFUR	0.330	0.207
TRINITROTOLUENE	0.000	0.000
VINYL ALCOHOL ACETATE RESIN	0.990	0.990
WAX	6.190	6.190

* Percentile (based on weight per item) averaged over all items in class identified.

CLASS SUMMARY FOR CLASS: 4a

	MAX WEIGHT %	AVG WEIGHT %
ALUMINUM	0.050	0.050
ALUMINUM NITRATE	1.670	1.670
ALUMINUM POWDER	6.210	4.903
ANTIMONY SULFIDE	1.250	0.108
BARIUM NITRATE	4.800	0.601
BARIUM PEROXIDE	0.330	0.330
CALCIUM	0.580	0.580
CALCIUM CARBONATE	0.900	0.900
CALCIUM RESINATE	0.030	0.030
CHARCOAL	15.000	3.870
DESENSITIZER	1.490	1.386
DIBUTYLPHTHALATE	9.050	6.121
DINITROTOLUENE	9.440	6.594
DIPHENYLAMINE	1.360	0.962
ETHYL CENTRALITE	0.600	0.130
GRAPHITE	4.140	0.380
HMX	19.790	10.370
LEAD	0.280	0.175
LEAD AZIDE	0.030	0.027
LEAD STYPHNATE	4.800	0.909
LEAD THIOCYANATE	0.130	0.058
MAGNESIUM	1.090	1.090
MAGNESIUM POWDER	1.010	1.010
MAGNESIUM/ALUMINUM ALLOY	12.040	3.610
METAL PELLETS	99.120	99.120
NITROCELLULOSE	91.400	63.726
NITROGLYCERIN	39.930	8.649
NYLON	1.040	1.040
PETN	50.000	33.355
POLYVINYL CHLORIDE	0.200	0.200
POTASSIUM	14.180	3.074
POTASSIUM CHLORATE	0.280	0.099
POTASSIUM CHLORIDE	0.030	0.030
POTASSIUM NITRATE	2.880	0.921

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 4a

	MAX WEIGHT %	AVG WEIGHT %
POTASSIUM PERCHLORATE	3.280	2.357
POTASSIUM SULFATE	0.600	0.593
RDX	97.580	46.136
SODIUM NITRATE	75.000	75.000
SODIUM SULFATE	0.450	0.450
STRONTIUM NITRATE	1.780	1.555
SULFUR	10.000	2.583
TETRACENE	0.420	0.420
TETRYL	1.300	1.300
TIN	0.630	0.580
TIN DIOXIDE	1.320	1.102
TRINITROTOLUENE	100.000	55.673
WAX	1.380	1.120

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 4b

	MAX WEIGHT %	AVG WEIGHT %
ALUMINUM	0.020	0.008
ALUMINUM POWDER	0.000	0.000
ANTIMONY	0.000	0.000
ANTIMONY SULFIDE	0.010	0.001
BARIUM	0.030	0.009
BARIUM CHROMATE	0.000	0.000
BARIUM NITRATE	1.400	0.335
BARIUM PEROXIDE	0.100	0.033
BORON POWDER	0.000	0.000
CALCIUM RESINATE	0.000	0.000
CARBORUNDUM	0.000	0.000
CHARCOAL	15.000	1.918
CRYOLITE	1.200	0.430
DESENSITIZER	3.810	1.410
DIBUTYLPHTHALATE	10.000	2.644
DIETHYLPHTHALATE	0.210	0.178
DINITROTOLUENE	9.960	5.120
DIPHENYLAMINE	1.030	0.590
ESTANE	5.010	5.010
ETHYL CENTRALITE	5.660	1.334
GASOLINE	84.040	84.040
GRAPHITE	0.580	0.150
LEAD	0.050	0.015
LEAD AZIDE	0.070	0.026
LEAD STYPHNATE	0.000	0.000
LEAD THIOCYANATE	0.010	0.001
MAGNESIUM	0.080	0.070
MAGNESIUM POWDER	0.400	0.093
METHYLPHTHALATE	0.270	0.270
NITROCELLULOSE	91.400	37.564
NITROGLYCERIN	23.510	12.345
NITROGUANIDINE	54.420	44.347
PERCHLOROPENTACYCLODECANE	0.030	0.010
PETN	11.700	7.450

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 4b

	MAX WEIGHT %	AVG WEIGHT %
POTASSIUM	2.520	0.768
POTASSIUM CHLORATE	0.450	0.080
POTASSIUM CHLORIDE	0.000	0.000
POTASSIUM NITRATE	75.100	6.580
POTASSIUM SULFATE	8.010	1.198
RDX	94.720	33.262
STEARIC ACID	0.370	0.218
STRONTIUM	0.050	0.030
STRONTIUM NITRATE	0.640	0.096
SULFUR	10.000	1.470
TETRACENE	0.000	0.000
TETRYL	2.240	0.555
TRINITROTOLUENE	99.680	32.252
VINYL ALCOHOL ACETATE RESIN	0.000	0.000
WAX	7.910	2.211
WHITE PHOSPHOROUS	82.830	41.510

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASSES 4A-4B COMBINED

	MAX WEIGHT %	AVG WEIGHT %
ALUMINUM	0.050	0.001
ALUMINUM NITRATE	1.670	0.012
ALUMINUM POWDER	6.210	0.286
ANTIMONY	0.000	0.000
ANTIMONY SULFIDE	1.250	0.011
BARIUM	0.030	0.000
BARIUM CHROMATE	0.000	0.000
BARIUM NITRATE	4.800	0.111
BARIUM PEROXIDE	0.330	0.006
BORON POWDER	0.000	0.000
CALCIUM	0.580	0.004
CALCIUM CARBONATE	0.900	0.013
CALCIUM RESINATE	0.030	0.000
CARBORUNDUM	0.000	0.000
CHARCOAL	15.000	0.505
CRYOLITE	1.200	0.016
DESENSITIZER	3.810	0.102
DIBUTYLPHTHALATE	10.000	1.191
DIETHYLPHTHALATE	0.210	0.005
DINITROTOLUENE	9.960	2.399
DIPHENYLAMINE	1.360	0.378
ESTANE	5.010	0.073
ETHYL CENTRALITE	5.660	0.372
GASOLINE	84.040	0.613
GRAPHITE	4.140	0.087
HMX	19.790	0.151
LEAD	0.280	0.014
LEAD AZIDE	0.070	0.003
LEAD STYPHNATE	4.800	0.046
LEAD THIOCYANATE	0.130	0.002

* Percentile (based on weight per item) averaged over all items in class identified.

CLASS SUMMARY FOR CLASSES 4A-4B COMBINED

	MAX WEIGHT %	AVG WEIGHT %
MAGNESIUM	1.090	0.009
MAGNESIUM POWDER	1.010	0.022
MAGNESIUM/ALUMINUM ALLOY	12.040	0.184
METAL PELLETS	99.120	0.724
METHYLPHTHALATE	0.270	0.004
NITROCELLULOSE	91.400	43.249
NITROGLYCERIN	39.930	5.273
NITROGUANIDINE	54.420	5.827
NYLON	1.040	0.008
PERCHLOROPENTACYCLODECANE	0.030	0.000
PETN	50.000	1.624
POLYVINYL CHLORIDE	0.200	0.001
POTASSIUM	14.180	0.207
POTASSIUM CHLORATE	0.450	0.014
POTASSIUM CHLORIDE	0.030	0.000
POTASSIUM NITRATE	75.100	2.069
POTASSIUM PERCHLORATE	3.280	0.052
POTASSIUM SULFATE	8.010	0.152
RDX	97.580	17.285
SODIUM NITRATE	75.000	0.547
SODIUM SULFATE	0.450	0.007
STEARIC ACID	0.370	0.006
STRONTIUM	0.050	0.001
STRONTIUM NITRATE	1.780	0.064
SULFUR	10.000	0.333
TETRACENE	0.420	0.003
TETRYL	2.240	0.119
TIN	0.630	0.008
TIN DIOXIDE	1.320	0.072
TRINITROTOLUENE	100.000	17.395

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASSES 4A-4B COMBINED

	MAX WEIGHT %	AVG WEIGHT %
VINYL ALCOHOL ACETATE RESIN	0.000	0.000
WAX	7.910	0.299
WHITE PHOSPHOROUS	82.830	0.606

* Percentile (based on weight per item) averaged over all items in class identified.

CLASS SUMMARY FOR CLASS: 5

	MAX WEIGHT %	AVG WEIGHT %
2-NITROPHENYLAMINE	1.000	0.600
AMMONIUM NITRATE	100.000	66.665
AMMONIUM PERCHLORATE	100.000	77.777
BORON	0.100	0.100
CANDELILLA WAX	0.100	0.100
CARBON BLACK	1.200	1.050
CHARCOAL	15.000	8.500
ETHYL CENTRALITE	0.900	0.767
HMX	16.000	16.000
INERT	2.000	2.000
LEAD SALICYLATE	1.500	0.850
LEAD-2-ETHYLHEXOLATE	1.500	0.850
NITROCELLULOSE	54.600	39.267
NITROGLYCERIN .	49.000	28.617
OCTOL	83.000	60.000
POTASSIUM CHLORIDE	33.330	33.330
POTASSIUM NITRATE	75.000	28.833
POTASSIUM PERCHLORATE	7.800	6.900
RDX	100.000	50.600
SILVER	1.000	1.000
SULFUR	10.000	5.500
TRIACETIN	9.700	4.950

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 6

	MAX WEIGHT %	AVG WEIGHT %
ALUMINUM POWDER	20.000	20.000
CALCIUM CHLORIDE	0.300	0.300
ETHYLENE OXIDE	98.920	98.920
HMX	94.000	94.000
LECITHIN	0.100	0.100
NITROCELLULOSE	0.700	0.700
NYLON	6.000	6.000
PARAFFIN	4.000	4.000
PETN	1.080	1.080
RDX	45.000	45.000
TETRYL	100.000	100.000
TRINITROTOLUENE	80.000	63.333
WAX	5.000	5.000

* Percentile (based on weight per item) averaged over all items in class identified.

CLASS SUMMARY FOR CLASS: 7

	MAX WEIGHT %	AVG WEIGHT %
ANTIMONY SULFIDE	0.000	0.000
BARIUM NITRATE	0.000	0.000
CHARCOAL	0.540	0.315
CHLOROACETOPHENONE	99.600	99.600
CHLOROBENZALDEHYDE	82.400	82.400
CN AGENT	100.000	100.000
CS AGENT	100.000	84.975
DIBUTYLPHTHALATE	0.390	0.390
GROUND GLASS	0.000	0.000
IRON OXIDE	0.030	0.030
LEAD	0.250	0.140
LEAD CHROMATE	0.000	0.000
LEAD THIOCYANATE	0.100	0.100
MAGNESIUM CARBONATE	12.000	11.980
MALONONITRATE	0.400	0.400
MALONONITRILE	0.860	0.860
NITROCELLULOSE	6.930	4.307
NITROGLYCERIN	5.690	5.690
O-CHLOROBENZALDAHYDE	39.230	39.230
POTASSIUM CHLORATE	27.000	17.967
POTASSIUM NITRATE	2.730	1.585
SILICON	0.080	0.080
SUGAR	18.000	17.965
SULFUR	0.360	0.210
TITANIUM	0.030	0.030
TRINITROTOLUENE	0.000	0.000
ZIRCONIUM POWDER	0.010	0.010

*** Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 8

	MAX WEIGHT %	AVG WEIGHT %
ALUMINUM POWDER	20.000	17.400
AMATOL	90.000	90.000
AMMONIUM NITRATE	75.000	75.000
BARIUM NITRATE	0.200	0.200
BARIUM POTASSIUM NITRATE	1.000	1.000
CALCIUM CHLORIDE	3.500	1.900
CALCIUM STEARATE	1.500	1.500
CELLULOSE	0.020	0.020
FUEL OIL #6	1.600	1.600
GLASS	0.200	0.200
GRAPHITE	0.500	0.500
LEAD AZIDE	19.000	9.505
LEAD STYPHNATE	3.000	3.000
LEAD THIOCYANATE	0.800	0.800
LECITHIN	0.100	0.100
MOTOR OIL	4.000	2.800
NITROCELLULOSE	4.800	2.750
NITROGLYCERIN	3.100	3.100
PETN	100.000	80.614
POLYISOBUTYLENE	2.100	0.963
POTASSIUM CHLORATE	0.800	0.800
POTASSIUM PERCHLORATE	0.700	0.700
RDX	100.000	75.826
SEBACATE	5.300	5.300
STARCH	5.000	5.000
TEFLON	9.000	9.000
TETRYL	75.000	75.000
TRINITROTOLUENE	100.000	45.675
WAX	4.000	1.733

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 9

	MAX WEIGHT %	AVG WEIGHT %
ALUMINUM POWDER	19.900	9.950
ANTIMONY SULFIDE	0.000	0.000
BARIUM	0.350	0.337
BARIUM CHROMATE	0.050	0.020
CALCIUM CHLORIDE	0.300	0.300
CHARCOAL	0.300	0.160
LEAD	0.150	0.073
LEAD AZIDE	0.300	0.125
LEAD STYPHNATE	0.100	0.100
LECITHIN	0.100	0.100
NICKEL ALLOY	0.010	0.010
NICKEL POWDER	0.090	0.063
NITROCELLULOSE	0.700	0.700
PETN	0.050	0.050
POTASSIUM CHLORATE	0.010	0.002
POTASSIUM NITRATE	1.500	0.790
POTASSIUM PERCHLORATE	0.080	0.048
RDX	100.000	57.131
SULFUR	0.200	0.105
TETRYL	100.000	24.993
TRINITROTOLUENE	100.000	59.096
WAX	3.990	1.025
ZIRCONIUM	0.090	0.090
ZIRCONIUM POWDER	0.070	0.048

* Percentile (based on weight per item) averaged over all items in class identified.

CLASS SUMMARY FOR CLASS: 10

	MAX WEIGHT %	AVG WEIGHT %
AMMONIUM PICRATE	3.370	3.370
ANTIMONY SULFIDE	0.000	0.000
BARIUM NITRATE	0.000	0.000
CHARCOAL	15.000	3.973
DIBUTYLPHTHALATE	2.840	2.495
DINITROTOLUENE	7.000	5.965
DIPHENYLAMINE	0.900	0.758
GRAPHITE	0.200	0.171
HE	19.800	14.323
LEAD	0.040	0.020
NITROCELLULOSE	91.400	76.277
POTASSIUM NITRATE	15.350	10.193
POTASSIUM SULFATE	0.600	0.514
RDX	45.300	20.272
SODIUM NITRATE	75.000	32.413
STEARIC ACID	0.690	0.690
SULFUR	10.000	2.649
TETRYL	0.000	0.000
TRINITROTOLUENE	42.770	20.801
WAX	2.240	1.900

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 11

	MAX WEIGHT %	AVG WEIGHT %
ANTIMONY SULFIDE	0.000	0.000
BARIUM CHROMATE	0.000	0.000
BARIUM NITRATE	0.000	0.000
BORON POWDER	0.000	0.000
CALCIUM SILICATE	0.130	0.130
CARBORUNDUM	0.000	0.000
GB	69.910	69.910
HD	93.000	93.000
LEAD AZIDE	0.010	0.010
LEAD STYPHNATE	0.000	0.000
POTASSIUM CHLORATE	0.000	0.000
RDX	16.300	16.300
TETRYL	5.320	5.320
TRINITROTOLUENE	13.630	7.650
WAX	0.010	0.010

* Percentile (based on weight per item) averaged over all items in class identified.

CLASS SUMMARY FOR CLASS: 12a

	MAX WEIGHT %	AVG WEIGHT %
2-NITRODIPHENYLAMINE	2.100	1.642
ACETYLENE	1.000	1.000
AKARDITE	0.700	0.567
ALUMINUM	40.000	18.000
AMMONIUM PERCHLORATE	50.000	38.267
AMMONIUM PICRATE	40.700	40.700
BARIUM CARBONATE	0.500	0.500
BARIUM NITRATE	30.000	4.938
CALCIUM CARBONATE	0.500	0.453
CALCIUM STEARATE	0.500	0.500
CANDELILLA WAX	0.200	0.127
CARBON BLACK	1.200	0.382
CELLULOSE	15.000	15.000
CENTRALITE	0.300	0.300
CHARCOAL	15.000	12.200
CHLORINATED WAX	4.500	4.500
COPPER CHROMITE	1.000	1.000
CORN STARCH	1.800	1.800
CRYOLITE	0.600	0.360
CUPRIC SALICYLATE	2.500	2.375
DI-N-PROPYL ADIPATE	5.900	2.520
DIBUTYLPHTHALATE	9.000	4.332
DIETHYLENE GLYCOL DINITRATE	36.700	29.200
DIETHYLPHTHALATE	10.900	7.900
DINITROTOLUENE	11.500	6.496
DIPHENYLAMINE	1.500	1.009
DIPHENYLPHTHALATE	2.000	2.000
ETHYL CELLULOSE	4.500	4.500
ETHYL CENTRALITE	8.000	2.615
ETHYLENE DIMETHACRYLATE	5.000	4.367
GRAPHITE	0.500	0.212
HMX	15.000	15.000
LEAD 2,4-DIHYDROXYBENZOATE	2.900	2.350
LEAD 2-ETHYLHEXOATE	2.300	1.540

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 12a

	MAX WEIGHT %	AVG WEIGHT %
LEAD 3-RESORCYLATE	3.000	2.125
LEAD CARBONATE	1.000	1.000
LEAD SALICYLATE	3.000	2.009
LEAD STEARATE	2.500	0.678
MAGNESIUM OXIDE	0.100	0.100
METHYL CELLULOSE	0.100	0.100
METHYL CENTRALITE	3.000	3.000
METRIOTRINITRATE	38.500	38.500
MONOBASIC CU SALICYLATE	2.000	2.000
N-BUTYL STEARATE	3.000	3.000
NITROCELLULOSE	98.200	69.122
NITROGLYCERIN	44.500	23.079
NITROGUANIDINE	54.700	51.020
POTASSIUM NITRATE	75.000	8.008
POTASSIUM PERCHLORATE	30.000	15.200
POTASSIUM SULFATE	2.000	0.951
RESORCINOL	1.700	1.633
SODIUM SULFATE	0.300	0.287
SULFUR	10.000	8.150
TIN	0.700	0.700
TIN DIOXIDE	1.100	1.100
TRIACETIN	11.000	8.767
TRIETHYLENE GLYCOL DINITRATE	3.000	3.000

* Percentile (based on weight per item) averaged over all items in class identified.

CLASS SUMMARY FOR CLASS: 12b

	MAX WEIGHT %	AVG WEIGHT %
2-NITROPHENYLAMINE	1.470	1.470
CARBON BLACK	1.200	1.200
CHARCOAL	7.800	2.637
CRYOLITE	0.290	0.290
DIBUTYLPHTHALATE	4.400	3.090
DINITROCELLULOSE	7.000	6.375
DINITROTOLUENE	10.000	9.580
DIPHENYLAMINE	1.000	0.950
ETHYL CENTRALITE	0.900	0.593
GRAPHITE	0.200	0.187
LEAD	1.530	1.240
NITROCELLULOSE	91.400	76.708
NITROGLYCERIN	40.000	25.295
NITROGUANIDINE.	53.450	53.450
POTASSIUM NITRATE	87.000	17.872
POTASSIUM PERCHLORATE	7.800	7.800
POTASSIUM SULFATE	0.600	0.560
SULFUR	5.200	1.760

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASSES 12A-12B COMBINED

	MAX WEIGHT %	AVG WEIGHT %
2-NITRODIPHENYLAMINE	2.100	0.244
2-NITROPHENYLAMINE	1.470	0.011
ACETYLENE	1.000	0.008
AKARDITE	0.700	0.013
ALUMINUM	40.000	0.703
AMMONIUM PERCHLORATE	50.000	0.897
AMMONIUM PICRATE	40.700	0.318
BARIUM CARBONATE	0.500	0.004
BARIUM NITRATE	30.000	0.309
CALCIUM CARBONATE	0.500	0.053
CALCIUM STEARATE	0.500	0.004
CANDELILLA WAX	0.200	0.011
CARBON BLACK	1.200	0.042
CELLULOSE	15.000	0.117
CENTRALITE	0.300	0.002
CHARCOAL	15.000	0.252
CHLORINATED WAX	4.500	0.035
COPPER CHROMITE	1.000	0.008
CORN STARCH	1.800	0.014
CRYOLITE	0.600	0.016
CUPRIC SALICYLATE	2.500	0.074
DI-N-PROPYL ADIPATE	5.900	0.098
DIBUTYLPHTHALATE	9.000	1.141
DIETHYLENE GLYCOL DINITRATE	36.700	0.456
DIETHYLPHTHALATE	10.900	0.370

*** Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASSES 12A-12B COMBINED

	MAX WEIGHT %	AVG WEIGHT %
DINITROCELLULOSE	7.000	0.100
DINITROTOLUENE	11.500	2.020
DIPHENYLAMINE	1.500	0.492
DIPHENYLPHTHALATE	2.000	0.016
ETHYL CELLULOSE	4.500	0.035
ETHYL CENTRALITE	8.000	0.811
ETHYLENE DIMETHACRYLATE	5.000	0.102
GRAPHITE	0.500	0.099
HMX	15.000	0.117
LEAD	1.530	0.029
LEAD 2,4-DIHYDROXYBENZOATE	2.900	0.073
LEAD 2-ETHYLHEXOATE	2.300	0.060
LEAD 3-RESORCYLATE	3.000	0.066
LEAD CARBONATE	1.000	0.016
LEAD SALICYLATE	3.000	0.173
LEAD STEARATE	2.500	0.048
MAGNESIUM OXIDE	0.100	0.002
METHYL CELLULOSE	0.100	0.001
METHYL CENTRALITE	3.000	0.023
METRIOTRINITRATE	38.500	0.301
MONOBASIC CU SALICYLATE	2.000	0.016
N-BUTYL STEARATE	3.000	0.023
NITROCELLULOSE	98.200	67.732
NITROGLYCERIN	44.500	14.494
NITROGUANIDINE	54.700	4.404

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASSES 12A-12B COMBINED

	MAX WEIGHT %	AVG WEIGHT %
POTASSIUM NITRATE	87.000	2.200
POTASSIUM PERCHLORATE	30.000	0.417
POTASSIUM SULFATE	2.000	0.273
RESORCINOL	1.700	0.038
SODIUM SULFATE	0.300	0.034
SULFUR	10.000	0.169
TIN	0.700	0.011
TIN DIOXIDE	1.100	0.026
TRIACETIN	11.000	0.411
TRIETHYLENE GLYCOL DINITRATE	3.000	0.023

* **Percentile (based on weight per item) averaged over all items in class identified.**

CLASS SUMMARY FOR CLASS: 14

	MAX WEIGHT %	AVG WEIGHT %
CHARCOAL	15.000	15.000
DIBUTYLAMINE	0.900	0.900
DINITROTOLUENE	7.000	7.000
GRAPHITE	0.200	0.200
NITROCELLULOSE	91.400	91.400
POTASSIUM NITRATE	75.000	75.000
POTASSIUM SULFATE	0.600	0.600
SULFUR	10.000	5.500

*** Percentile (based on weight per item) averaged over all items in class identified.**

APPENDIX C-4

AVERAGE AND RANGE OF WEIGHT COMPOSITION BY CONSTITUENT (OB AND OD)

Rev. 1 (7/95)

OPEN BURNING
(CLASSES: 5, 12a, and 12b)

	MAX WEIGHT %	AVG WEIGHT %
2-NITRODIPHENYLAMINE	2.100	0.223
2-NITROPHENYLAMINE	1.470	0.019
ACETYLENE	1.000	0.007
AKARDITE	0.700	0.012
ALUMINUM	40.000	0.643
AMMONIUM NITRATE	100.000	0.952
AMMONIUM PERCHLORATE	100.000	2.487
AMMONIUM PICRATE	40.700	0.291
BARIUM CARBONATE	0.500	0.004
BARIUM NITRATE	30.000	0.282
BORON	0.100	0.001
CALCIUM CARBONATE	0.500	0.049
CALCIUM STEARATE	0.500	0.004
CANDELILLA WAX	0.200	0.011
CARBON BLACK	1.200	0.054
CELLULOSE	15.000	0.107
CENTRALITE	0.300	0.002
CHARCOAL	15.000	0.352
CHLORINATED WAX	4.500	0.032
COPPER CHROMITE	1.000	0.007
CORN STARCH	1.800	0.013
CRYOLITE	0.600	0.015
CUPRIC SALICYLATE	2.500	0.068
DI-N-PROPYL ADIPATE	5.900	0.090
DIBUTYLPHTHALATE	9.000	1.043
DIETHYLENE GLYCOL DINITRATE	36.700	0.417
DIETHYLPHTHALATE	10.900	0.339
DINITROCELLULOSE	7.000	0.091
DINITROTOLUENE	11.500	1.847
DIPHENYLAMINE	1.500	0.450
DIPHENYLPHTHALATE	2.000	0.014
ETHYL CELLULOSE	4.500	0.032
ETHYL CENTRALITE	8.000	0.758
ETHYLENE DIMETHACRYLATE	5.000	0.094

• Percentile (based on weight per item) averaged over all classes identified.

Rev. 1 (7/95)

OPEN BURRNING
(CLASSES: 5, 112a, and 12b)

	MAX WEIGGHT %	AVG WEIGHT %
GRAPHITE	0.500	0.090
HMX	16.000	0.221
INERT	2.000	0.014
LEAD	1.530	0.027
LEAD 2,4-DIHYDROXYBENZOATE	2.900	0.067
LEAD 2-ETHYLHEXOATE	2.300	0.055
LEAD 3-RESORCYLATE	3.000	0.061
LEAD CARBONATE	1.000	0.014
LEAD SALICYLATE	3.000	0.170
LEAD STEARATE	2.500	0.044
LEAD-2-ETHYLHEXOLATE	1.500	0.012
MAGNESIUM OXIDE	0.100	0.001
METHYL CELLULOSE	0.100	0.001
METHYL CENTRALITE	3.000	0.021
METRIOTRINITRATE	38.500	0.275
MONOBASIC CU SALICYLATE	2.000	0.014
N-BUTYL STEARATE	3.000	0.021
NITROCELLULOSE	98.200	63.609
NITROGLYCERIN	49.000	14.478
NITROGUANIDINE	54.700	4.026
OCTOL	83.000	0.857
POTASSIUM CHLORIDE	33.330	0.238
POTASSIUM NITRATE	87.000	2.629
POTASSIUM PERCHLORATE	30.000	0.480
POTASSIUM SULFATE	2.000	0.250
RDX	100.000	0.723
RESORCINOL	1.700	0.035
SILVER	1.000	0.007
SODIUM SULFATE	0.300	0.031
SULFUR	10.000	0.233
TIN	0.700	0.010
TIN DIOXIDE	1.100	0.024
TRIACETIN	11.000	0.446
TRIETHYLENE GLYCOL DINITRATE	3.000	0.021

* Percentile (based on weight per item) averaged over all classeses identified.

Rev. 1 (7/95)

OPEN BURNING[1]
(CLASSES: 1b, 1c, 3, 4, 5, 9, 10, 12a, and 12b)

	MAX WEIGHT %	AVG WEIGHT %
2-NITRODIPHENYLAMINE	2.100	0.082
2-NITROPHENYLAMINE	1.470	0.007
ACETONE	0.000	0.000
ACETYLENE	1.000	0.003
AKARDITE	0.700	0.004
ALUMINUM	40.600	0.263
ALUMINUM NITRATE	1.670	0.004
ALUMINUM POWDER	25.370	0.296
AMMONIUM NITRATE	100.000	0.548
AMMONIUM PERCHLORATE	100.000	0.916
AMMONIUM PICRATE	40.700	0.116
ANTIMONY	50.000	0.263
ANTIMONY SULFIDE	17.600	0.185
ASPHALTOM	4.910	0.013
BARIUM	3.650	0.018
BARIUM CARBONATE	0.500	0.001
BARIUM CHROMATE	25.000	0.077
BARIUM NITRATE	41.300	0.664
BARIUM PEROXIDE	0.330	0.002
BINDER	3.240	0.009
BORON	0.410	0.001
BORON POWDER	0.020	0.000
CALCIUM	0.580	0.002
CALCIUM CARBONATE	0.900	0.023
CALCIUM CHLORIDE	0.300	0.001
CALCIUM PHOSPHATE	0.400	0.002
CALCIUM RESINATE	0.030	0.000
CALCIUM SILICIDE	8.300	0.044
CALCIUM STEARATE	0.500	0.002
CANDELILLA WAX	0.200	0.004
CARBON BLACK	1.200	0.020
CARBORUNDUM	0.010	0.000
CELLULOSE	15.000	0.039
CENTRALITE	0.300	0.001

* Percentile (based on weight per item) averaged over all classes identified.

Rev. 1 (7/95)

OPEN BURNING[1]
(CLASSES: 1b, 1c, 3, 4, 5, 9, 10, 12a, and 12b)

	MAX WEIGHT %	AVG WEIGHT %
CHARCOAL	15.600	0.957
CHLORINATED WAX	4.500 .	0.012
COBALT NAPHTHANATE	0.070	0.000
COPPER CHROMITE	1.000	0.003
CORN STARCH	1.800	0.005
CRYOLITE	1.200	0.011
CUPRIC SALICYLATE	2.500	0.025
DESENSITIZER	3.810	0.037
DEXTRIN	0.020	0.000
DI-N-PROPYL ADIPATE	5.900	0.033
DIAZODINITROPHENOL	20.000	0.157
DIBUTYLPHTHALATE	10.000	0.835
DIETHYLENE GLYCOL DINITRATE	36.700	0.154
DIETHYLPHTHALATE	10.900	0.128
DINITROCELLULOSE	7.000	0.052
DINITROTOLUENE	11.500	2.058
DIPHENYLAMINE	50.000	0.499
DIPHENYLPHTHALATE	2.000	0.005
ESTANE	5.010	0.026
ETHYL CELLULOSE	4.500	0.012
ETHYL CENTRALITE	8.000	0.417
ETHYLENE DIMETHACRYLATE	5.000	0.034
FERRIC OXIDE	0.390	0.001
FIRST FIRE	6.500	0.017
FUEL OIL #6	7.860	0.021
GASOLINE	84.040	0.221
GLASS	10.500	0.054
GRAPHITE	4.140	0.078
GROUND GLASS	10.500	0.111
GUM ARABIC	8.300	0.044
HE	19.800	0.226
HEXACHLOROBENZENE	14.740	0.039
HMX	19.790	0.136
INERT	2.000	0.005

• Percentile (based on weight per item) averaged over all classes identified.

Rev. 1 (7/95)

OPEN BURNING[1]
(CLASSES: 1b, 1c, 3, 4, 5, 9, 10, 12a, and 12b)

	MAX WEIGHT %	AVG WEEIGHT %
IRON OXIDE	6.990	0.030
LAMANIC	91.020	0.257
LEAD	61.760	0.757
LEAD 2,4-DIHYDROXYBENZOATE	2.900	0.025
LEAD 2-ETHYLHEXOATE	2.300	0.020
LEAD 3-RESORCYLATE	3.000	0.022
LEAD AZIDE	80.810	0.957
LEAD CARBONATE	1.000	0.005
LEAD SALICYLATE	3.000	0.063
LEAD STEARATE	2.500	0.016
LEAD STYPHNATE	8.300	0.088
LEAD THIOCYANATE	38.000	0.669
LEAD-2-ETHYLHEXOLATE	1.500	0.004
LECITHIN	0.100	0.000
LINSEED OIL	2.950	0.008
LUPERSOL	0.070	0.000
MAGNESIUM	44.860	0.208
MAGNESIUM OXIDE	0.100	0.001
MAGNESIUM POWDER	44.480	0.353
MAGNESIUM/ALUMINUM ALLOY	12.040	0.067
METAL PELLETS	99.120	0.261
METHYL CELLULOSE	0.100	0.000
METHYL CENTRALITE	3.000	0.008
METHYLPHTHALATE	0.270	0.001
METRIOTRINITRATE	38.500	0.101
MONOBASIC CU SALICYLATE	2.000	0.005
N-BUTYL STEARATE	3.000	0.008
NICKEL ALLOY	6.120	0.016
NICKEL POWDER	0.490	0.002
NITROCELLULOSE	98.200	46.297
NITROGLYCERIN	49.000	7.462
NITROGUANIDINE	54.700	3.584
NITROSTARCH	5.000	0.039
NYLON	1.040	0.003

* Percentile (based on weight per item) averaged over all classes identified.

Rev. 1 (7/95)

OPEN BURNING[1]
(CLASSES: 1b, 1c, 3, 4, 5, 9, 10, 12a, and 12b)

	MAX WEIGHT %	AVG WEIGHT %
OCTOL	83.000	0.316
PENTAERYTHRITOL	0.150	0.001
PERCHLOROPENTACYCLODECANE	0.030	0.000
PETN	100.000	1.244
POLYVINYL CHLORIDE	0.200	0.001
POTASSIUM	14.180	0.075
POTASSIUM CHLORATE	60.000	1.261
POTASSIUM CHLORIDE	33.330	0.088
POTASSIUM NITRATE	87.000	3.864
POTASSIUM PERCHLORATE	40.870	0.373
POTASSIUM PERMANGANATE	50.000	0.263
POTASSIUM SULFATE	8.010	0.188
RAREOX	0.020	0.000
RDX	100.000	10.580
RED GUM	0.080	0.000
RESORCINOL	1.700	0.013
SILICON	20.130	0.089
SILVER	1.000	0.003
SODIUM NITRATE	99.580	1.214
SODIUM OXALATE	0.050	0.000
SODIUM SALCYLATE	0.770	0.002
SODIUM SULFATE	0.450	0.014
STEARIC ACID	0.690	0.004
STRONTIUM	0.050	0.000
STRONTIUM NITRATE	10.820	0.080
SULFUR	10.400	0.527
TETRACENE	8.300	0.075
TETRYL	100.000	1.550
TIN	0.700	0.007
TIN DIOXIDE	1.320	0.035
TITANIUM	6.960	0.018
TRIACETIN	11.000	0.164
TRIETHYLENE GLYCOL DINITRATE	3.000	0.008
TRINITROTOLUENE	100.000	9.421

• Percentile (based on weight per item) averaged over all classes identified.

Rev. 1 (7/95)

OPEN BURNING[1]
(CLASSES: 1b, 1c, 3, 4, 5, 9, 10, 12a, and 12b)

	MAX WEIGHT %	AVG WEIGHT %
VINYL ALCOHOL ACETATE RESIN	0.990	0.003
WAX	7.910	0.179
WHITE PHOSPHOROUS	82.830	0.218
ZINC POWDER	54.040	0.142
ZIRCONIUM	4.720	0.013
ZIRCONIUM POWDER	2.380	0.018

• Percentile (based on weight per item) averaged over all classes identified.

Rev. 1 (7/95)

OPEN DETONATI
(CLASSES: 1b, 2, 3, 4, 6, 7, 8, 9, 10, 11, and 14)

	MAX WEIGHT %	AVG WEIGHT %
1,4-DI-P-TOLUIIDINOANTHRAQUINON	32.770	0.274
1,4-DIAMINO-2,2,3-DIHYDIANTHRAQU	33.470	0.114
1-N-METHLAMINO-ANTHRAQUINONE	42.120	0.350
2-(2'-QUINOLYLL)-1,3-INDANDIONE	40.410	0.179
2-NITROPHENYLLAMINE	0.910	0.003
ACETONE	0.000	0.000
ALUMINUM	9.840	0.051
ALUMINUM NITRATE	1.670	0.006
ALUMINUM POWDER	20.000	0.889
AMATOL	90.000	0.307
AMMONIUM NITRATE	75.000	0.256
AMMONIUM PICRATE	3.370	0.012
ANTIMONY	0.000	0.000
ANTIMONY SULFIDE	2.150	0.020
ASBESTOS	1.600	0.005
ASPHALTOM	4.910	0.017
BARIUM	3.650	0.024
BARIUM CHROMATE	25.000	0.114
BARIUM NITRATE	41.300	0.350
BARIUM PEROXIDE	0.330	0.003
BARIUM POTASSIUM NITRATE	1.000	0.003
BENZANTHRONE	24.440	0.115
BINDER	3.240	0.011
BORON	0.410	0.001
BORON POWDER	0.550	0.006
BUTYL RUBBER	4.770	0.016
CALCIUM	0.580	0.002
CALCIUM CARBONATE	0.900	0.006
CALCIUM CHLORIDE	3.500	0.015
CALCIUM PHOSPHATE	0.400	0.003
CALCIUM RESINATE	0.030	0.000
CALCIUM SILICATE	0.130	0.000
CALCIUM SILICIDE	0.000	0.000
CALCIUM STEARATE	1.500	0.026

* Percentile (based on weight per item) averaged over all classes identified.

Rev. 1 (7/95)

OPEN DETONATIION
(CLASSES: 1b, 2, 3, 4, 6, 7, 8, 9, 10, 11, and 14)

	MAX WEIGHT %	AVG WEIGHT %
CARBORUNDUM	0.010	0.000
CELLULOSE	0.020	0.000
CHARCOAL	15.600	0.765
CHLOROACETOPHENONE	99.600	0.340
CHLOROBENZALDEHYDE	82.400	0.281
CHROMIC ACID	0.910	0.003
CHROMIC OXIDE	0.910	0.006
CN AGENT	100.000	0.341
COBALT NAPHTHANATE	0.070	0.000
CRYOLITE	1.200	0.008
CS AGENT	100.000	1.160
DESENSITIZER	3.810	0.048
DEXTRIN	36.790	0.156
DIAZODINITROPHENOL	19.700	0.067
DIBENZO(B,D&F)CHRYSENE7,14-DI	11.110	0.051
DIBUTYLAMINE	0.900	0.003
DIBUTYLPHTHALATE	10.000	0.749
DIETHYLPHTHALATE	0.420	0.005
DINITROCELLULOSE	7.000	0.024
DINITROTOLUENE	10.000	2.210
DIPHENYLAMINE	1.360	0.302
ESTANE	5.010	0.034
ETHYL CENTRALITE	5.660	0.174
ETHYLENE OXIDE	98.920	0.338
FERRIC NITRATE	0.000	0.000
FERRIC OXIDE	0.390	0.001
FIRST FIRE	6.500	0.022
FUEL OIL #6	7.860	0.032
GASOLINE	84.040	0.287
GB	69.910	0.239
GLASS	0.200	0.001
GRAPHITE	4.140	0.068
GROUND GLASS	0.190	0.001
HD	93.000	0.317

* **Percentile (based on weight per item) averaged over all classes identified.**

Rev. 1 (7/95)

OPEN DETONATION
(CLASSES: 1b, 2, 3, 4, 6, 7, 8, 9, 10, 11, and 14)

	MAX WEIGHT %	AVG WEIGHT %
HE	19.800	0.293
HEXACHLOROBENZENE	14.740	0.050
HEXACHLOROETHANE	46.000	0.577
HMX	94.000	0.392
INERT	15.700	0.054
IRON OXIDE	6.990	0.039
LACTOSE	17.920	0.061
LAMANIC	91.020	0.333
LEAD	61.760	0.569
LEAD AZIDE	80.810	0.605
LEAD CHROMATE	0.000	0.000
LEAD STYPHNATE	5.180	0.061
LEAD THIOCYANATE	0.800	0.006
LECITHIN	0.100	0.001
LINSEED OIL	2.950	0.010
LUPERSOL	0.070	0.000
MAGNESIUM	44.860	0.167
MAGNESIUM CARBONATE	20.220	0.207
MAGNESIUM POWDER	44.480	0.458
MAGNESIUM ALUMINUM ALLOY	12.040	0.086
MALONONITRATE	0.400	0.001
MALONONITRILE	0.860	0.003
METAL PELLETS	99.120	0.338
METHYLPHTHALATE	0.270	0.002
MOTOR OIL	4.000	0.019
NICKEL ALLOY	6.120	0.021
NICKEL POWDER	0.490	0.003
NITROCELLULOSE	91.400	33.138
NITROGLYCERIN	39.930	2.569
NITROGUANIDINE	54.420	2.838
NITROSTARCH	4.900	0.017
NITROTOLUENE	85.000	0.290
NYLON	6.000	0.024
O-CHLOROBENZALDAHYDE	39.230	0.134

* Percentile (based on weight per item) averaged over all classes identified.

Rev. 1 (7/95)

OPEN DETONATTION
(CLASSES: 1b, 2, 3, 4, 6, 7, 83, 9, 10, 11, and 14)

	MAX WEIGHT %%	AVG WEIGHT %
PARAFFIN	4.00800	0.014
PERCHLOROPENTACYCLODECANE	0.03130	0.000
PETN	100.00800	2.480
POLYISOBUTYLENE	2.10100	0.026
POLYVINYL CHLORIDE	0.20200	0.001
POTASSIUM	14.18180	0.108
POTASSIUM CHLORATE	59.00800	1.254
POTASSIUM CHLORIDE	0.03130	0.000
POTASSIUM NITRATE	75.10100	2.996
POTASSIUM PERCHLORATE	19.65550	0.119
POTASSIUM SULFATE	8.01110	0.136
RAREOX	0.02120	0.000
RDX	100.00800	17.571
RED PHOSPHOROUS	90.63630	0.309
SEBACATE	5.3300	0.036
SILICON	20.11130	0.116
SODIUM BICARBONATE	32.9930	0.306
SODIUM NITRATE	99.5580	1.574
SODIUM OXALATE	0.0.050	0.000
SODIUM SULFATE	0.4.450	0.003
STARCH	5 5.000	0.017
STEARIC ACID	0.6.690	0.005
STRONTIUM	0.0.050	0.000
STRONTIUM NITRATE	10.8.820	0.104
SUGAR	18.8.000	0.123
SULFUR	12.2.360	0.571
TEFLON	9 9.000	0.031
TETRACENE	0.850	0.006
TETRYL	100.0.000	2.592
TETRYTOL	1.750	0.006
TIN	0.630	0.004
TIN DIOXIDE	1.320	0.034
TITANIUM	6.960	0.024
TRINITROTOLUENE	1000.000	14.992

* Percentile (based on weight per item) averaged over all classes identified.

Rev. 1 (7/95)

OPEN DETONATION
(CLASSES: 1b, 2, 3, 4, 6, 7, 8, 9, 10, 11, and 14)

	MAX WEIGHT %	AVG WEIGHT %
VINYL ALCOHOL ACETATE RESIN	1.950	0.010
WAX	7.910	0.260
WHITE PHOSPHOROUS	99.380	2.843
YELLOW DYE	54.560	0.186
YELLOW SMOKE B-10	6.700	0.023
ZINC OXIDE	48.000	0.609
ZINC POWDER	54.040	0.184
ZIRCONIUM	4.720	0.016
ZIRCONIUM POWDER	2.380	0.024

* Percentile (based on weight per item) averaged over all classes identified.

APPENDIX C-5

CHARACTERIZATION OF TYPICAL CASINGS

APPENDIX C-5

CHARACTERIZATION OF TYPICAL CASINGS

On an annual basis, the average composition of the casing is estimated as follows:

• Brass	<3%
• Copper	<1%
• Aluminum	<2%
• Fiberglass	<1%
• Plastic	<1%
• Carbon steel	92%

Brass consists of approximately 85% copper and 15% zinc. The manganese content of carbon steel is approximately 0.6%. Styrene (which is also a potential OD treatment emission) was selected as a surrogate for plastic and fiberglass. Therefore, the following casing composition has been assumed:

• Copper	3.55%
• Zinc	0.45%
• Aluminum	2%
• Styrene	2%
• Manganese	0.55%
• Iron	91.45%

The Army has conducted OD emission tests for the Military Services (U.S. Army, January 1992; U.S. Air Force, January 1994). These tests have included energetic material items with casings. The relatively high particulate (PM10) emission factors (compared to energetics without casings) based on these tests are assumed to including casing contributions. Therefore, the tests' average (0.24 lb/lb) and 95 percentile upper confidence limit (0.63 lb/lb) particulate (PM10) emission factors have been used to determine conservative long-term (greater than 24 hours) and short-term (24 hours or less) casing emissions, respectively.

The previously specified chemical composition fractions for typical casings were multiplied by the test-derived particulate emission factors to obtain conservative constituent-specific emission factors for casings as follows:

Constituent	Short term (≤24-h exposures)	Long-term (>24-h exposures)
• Copper	2.2 E-2	8.5 E-3
• Zinc	2.8 E-3	1.1 E-3
• Aluminum	1.3 E-2	4.8 E-3
• Styrene	1.3 E-2	4.8 E-3
• Manganese	3.5 E-3	1.3 E-3
• Iron	5.8 E-1	2.2 E-1

DEPOT.XLS
5/18/94

DODAC No.	Munition	Description	Base	N.E.W. (lb)	Total Wt (lb)	Ratio of Inert Mat'l to NEW
1315-C505	CTG	105-MM APDS-T CARTRIDGE, M392A2	SVAD	12.0360	41.0000	2.4064
1315-C521	CTG	105-MM APFSDS-T CARTRIDGE, M735	SVAD	13.4000	39.5000	1.9478
1315-C440	CTG	105-MM BLANK CARTRIDGE, M395	SVAD	1.7100	6.2400	2.6491
1315-C508	CTG	105-MM HEAT-T CARTRIDGE, M456 SERIES	SVAD	14.1400	48.0000	2.3945
1315-C518	CTG	105-MM HEP-T CARTRIDGE, M393A2	SVAD	15.7008	45.0000	1.8662
1315-C444	CTG	105-MM HIGH EXPLOSIVE CARTRIDGE WITH PD FUZE (M1)	SVAD	7.4508	42.0000	4.6376
1315-C445	CTG	105-MM HIGH EXPLOSIVE CARTRIDGE WITHOUT FUZE (M1)	SVAD	8.3910	39.9200	3.7575
1315-C442	CTG	105-MM HIGH EXPLOSIVE CARTRIDGE, M444	SVAD	10.1300	42.0000	3.1461
1315-C503	CTG	105-MM TP-T CARTRIDGE, M395A1	SVAD	5.9000	45.0000	6.6271
1315-C650	CTG	106-MM HEAT CARTRIDGE WITH PIBD FUZE, M344A1	SVAD	10.8900	37.2300	2.4187
1315-C651	CTG	106-MM HEP-T CARTRIDGE, M346 SERIES	SVAD	15.7200	37.3700	1.3772
1305-A776	CTG	20-MM INC M96 SNGL RD	LBAD	0.1950	0.5500	1.8205
1305-A872	CTG	20-MM API MK107 MOD 1 SINGLE ROUND	LBAD	0.1296		
1305-A873	CTG	20-MM AP-T MK108 MOD 1 SNGL RD	LBAD	0.1052		
1305-A876	CTG	20-MM TP MK105 MOD 0 SNGL RD	LBAD	0.0932		
1305-A884	CTG	20-MM API M53 LNKD	LBAD	0.0954	0.5686	4.9602
1305-A892	CTG	20-MM HPT M54A1 SNGL RD	LBAD	0.0861	0.6274	6.2869
1305-A899	CTG	20-MM FIRING CIRCUIT TEST MK109 MOD 0	LBAD	0.0885	0.6300	6.1186
1305-A974	CTG	25-MM APDS-T M791 LNKD	LBAD	0.2227		
1305-B113	CTG	30-MM TP MK42 LNKD LHF	LBAD			
1305-B114	CTG	30-MM HEI M32-1 LNKD RHF	LBAD	0.2886		
1305-B120	CTG	30-MM TP M788 LNKD RHF	LBAD	0.1118		
1310-B551	CTG	40-MM AP M81A1 CLIPPED	LBAD	0.7200		
1310-B559	CTG	40-MM HEI-T-SD 4/CLIP	LBAD	0.2020	4.7500	22.5149
1310-B568	CTG	40-MM HE M406	LBAD	0.0780	0.5030	5.4487
1310-B586	CTG	57-MM HE M306 A1	LBAD	1.5500	5.4600	2.5226
1310-B587	CTG	57-MM HEAT M307 SERIES	LBAD	1.4150	5.4300	2.8375
1310-B632	CTG	60-MM HE M49 SERIES	LBAD	0.8590	3.4850	3.1538
1310-B643	CTG	60-MM HE M888	LBAD	0.9006		
1315-C306	CTG	3-IN 50 CAL HE-IR MK33		4.9900		
1315-C027	CTG	75-MM HE M48	LBAD	1.4900	18.2400	11.2416
1315-C051	CTG	75-MM HE M309 SERIES	LBAD	4.7900	22.3700	3.6701
1315-C052	CTG	75-MM HEAT-T M319	LBAD	4.3774	21.0600	3.8111
1315-C053	CTG	75-MM HEP-T M349	LBAD	6.1076	16.5200	1.7048
1315-C056	CTG	75-MM SMK WP M311	LBAD	4.8800	23.2000	3.7541
1315-C057	CTG	75-MM HE M309A1	LBAD	4.7908	22.3700	3.6701
1315-C122	CTG	76-MM HE M352	LBAD	1.4400	25.5200	16.4795
1315-C128	CTG	76-MM SMK WP M361	LBAD	0.1600	25.8200	160.3750
1315-C136	CTG	3-IN 50 CAL VT MK33	LBAD	4.9900		
1315-C143	CTG	3-IN 50 CAL AP MK29	LBAD	4.1400		
1315-C152	CTG	3-IN 50 CAL VT RD MK33	LBAD	4.9900		
1315-C164	CTG	3-IN 50 CAL VT NON-FRAG MK33	LBAD	4.6200		

DODAC No.	Munition	Description	Base	N.E.W.	Total Wt	Ratio of Inert
				(lb)	(lb)	Mat'l to NEW
1315-C178	CTG	3-IN 50 CAL BL-T MK27	LBAD	4.0000		
1315-C222	CTG	81-MM HE M362 SERIES W/PD FUZE	LBAD	2.3330	9.4200	3.0377
1315-C223	CTG	81-MM HE M362 W/O FUZE	LBAD	2.3330	8.6200	2.6949
1315-C265	CTG	90-MM HE M71 W/MT08 FUZE M502	LBAD	9.4680	41.5600	3.3932
1315-C287	CTG	90-MM HE-T M71A1	LBAD	7.4600	39.1700	4.2507
1315-C299	CTG	3-IN 50 CAL AA MK27 NON-FL	LBAD	4.7500		
1315-C305	CTG	3-IN 50 CAL ILLUM MK25 MOD8	LBAD	5.0300		
1315-C319	CTG	3-IN 50 CAL VT NON-FRAG MK31	LBAD	4.4200		
1315-C322	CTG	3-IN 50 CAL HE-IR MK31 FLASHLESS	LBAD	4.9900		
1315-C341	CTG	3-IN 50 CAL BL-P MK29/27/185 FLASHLESS	LBAD	4.0000		
1315-C348	CTG	3-IN 50 CAL HC MK33 NON-FL	LBAD	5.2700		
1315-C375	CTG	3-IN 50 CAL VT NON-FRAG MK36 NFL	LBAD	6.5500		
1315-C429	CTG	105-MM HEP-T M393 SERIES	LBAD	12.5400	45.0000	2.5885
1315-C438	CTG	105-MM HE M1 W/O FUZE	LBAD	7.5730	39.9200	4.2714
1315-C510	CTG	105-MM TP-T M467	LBAD	5.9400	45.0000	6.5758
1315-C512	CTG	105-MM SMK WP-T M416 W/PD FUZE	LBAD	6.3000	45.5000	6.2222
1315-C699	CTG	4.2-IN HE M329A2 W/O FUZE	LBAD	6.7250	22.0000	2.2714
1315-C704	CTG	4.2-IN HE M329 SERIES W/PD FUZE	LBAD	8.9386	27.0700	2.0284
1315-C705	CTG	4.2-IN HE M329 SERIES W/O FUZE	LBAD	8.1360	24.9200	2.0629
1315-C706	CTG	4.2-IN ILLUM M335 SERIES	LBAD	0.7800	26.0000	32.3333
1315-C800	PJ & PJCHG	120-MM HE T15E3	LBAD	20.3400	50.4100	1.4784
1315-C801	PJ & PPCHG	120-MM HE M356	LBAD	20.3400	50.4100	1.4784
1315-C806	PJ & PPCHG	120-MM SMK WP-T116E3	LBAD	12.3000	50.4100	3.0984
1315-C807	PJ & PPCHG	120-MM HEAT-T M469	LBAD	26.4610	31.1100	0.1669
1320-D151	BURSTER PROJ.	M71 F/GAS PROJ. 155 MM	LBAD	2.4500		
1320-D485	PROJ.	155-MM HE M101	LBAD	15.8450	95.4150	5.0218
1320-D510	PROJ.	155-MM HEAT M712 (COPPERHEAD)	LBAD	14.7590	138.0000	8.3502
1320-D592	CTG	152-MM HE M657E2	LBAD	15.5330	48.5000	2.1224
1345-K090	MINE	AP M2 SERIES	LBAD	2.8700	6.5000	1.2648
1345-K250	MINE	AT HEAVY M19 NONMETALLIC	LBAD	21.0000	27.6800	0.3181
1375-M060	CHG	DEMO ROLL M186 25 LB COMP M-6	LBAD	25.0000		
1375-M757	CHG ASSY	DEMO 143 COMP C-4 20Z.5 LBS.	LBAD	20.0000		
1320-D381	CTG	152-MM HEAT-T CARTRIDGE, M409 SERIES	SVAD	13.2400	48.5000	2.6631
1320-D383	CTG	152-MM TP-T CARTRIDGE, M411 SERIES	SVAD	6.6232	49.3000	6.4435
1320-D563	PROJ.	155-MM HIGH-EXPLOSIVE ANTIPERSONNEL PROJECTILE M485 SERIES	--------	6.3620	102.6000	15.1270
1320-D505	PROJ.	155-MM HIGH EXPLOSIVES PROJECTILE, RAAM-L, M718	SVAD	11.3400	130.0000	10.4638
1320-D544	PROJ.	155-MM HIGH-EXPLOSIVE PROJECTILE, M107 (TNT) 00-529-7531	MISC	14.6100		
1320-D909	PROJ.	155-MM HIGH-EXPLOSIVE PROJECTILE, RAAM-S, M741	SVAD	11.7400	130.0000	10.0733
1320-D579	PROJ.	155-MM HIGH-EXPLOSIVE PROJECTILE, RAP M549 SERIES (COMPOSITION B)		16.3670	96.0000	4.8655
1320-D570	CTG	165-MM HEP CARTRIDGE, M123A1 (COMPOSITION A3)	SVAD	16.0000	67.6000	3.2250
1320-D572	PROJ.	175-MM HIGH EXPLOSIVE PROJECTILE M437A1/M437A2 (TNT)	SVAD	31.3000	147.0000	3.6965
1320-D591	PROJ.	175-MM HIGH-EXPLOSIVE PROJECTILE, M437A2 (COMPOSITION B)	SVAD	31.3650	147.0000	3.6868

APPENDIX D

SECTION 4.0 SUPPORT MATERIAL

- D-1 Summary of OB/OD Emission Tests
- D-2 High-Explosive Field Tests -
  Explosion Phenomena and Environmental Impacts
  (DNA, October 1981)
  - OD Crater Volume -
- D-3 Open Detonation Fugitive Dust Emission Factors (December 1993)
- D-4 Summary of OB/OD Environmental Partitioning Factors

APPENDIX D-1

SUMMARY OF OB/OD EMISSION TESTS

1. AMCCOM/USAFACC OB/OD Emission Studies

1.1 Introduction

A test planning directive to conduct testing of open detonation (OD) of explosives and open burning (OB) of propellants in support of U.S.Army Armament, Munitions and Chemical Command (AMCCOM) was issued on April 28, 1988. A Technical Steering Committee (TSC) Symposium was held in July, 1988 followed shortly by commencement of testing. Testing of small quantities (i.e. 0.5 pounds) was conducted during December, 1988, January and February, 1989, followed by Field Testing of large quantities (1,980 to 2,030 pounds in detonation tests and 3,140 to 7,040 pounds in burn tests) during June and October, 1989 and August and September, 1990). Subsequently a series of tests was conducted by the U.S. Air Force Air Combat Command (USAFACC) to extend the studies to energetics used by the Air Force.

The remainder of this section summarizes the studies, consolidates and compares the data, and presents the complete set of emission factors.

1.2 History of Bang Box Test Development

<u>Planning</u>

In the mid-1980s, AMCCOM foresaw the need for characterizing emissions resulting from the OB/OD of propellants and explosives and embarked on an ambitions program to obtain data which would be suitable for the needs of environmental agencies in their role of issuing permits to operate such activities. Following a preliminary test conducted to determine technology gaps, a symposium was held in July, 1988 to consider means of resolving the gaps. The symposium reviewed existing and emerging technologies potentially suited to OB/OD testing needs. The symposium produced numerous recommendations and a technical steering committee (TSC) was formed to provide technical direction.

The TSC proposed a list of 71 target analytes for consideration in developing analysis plans. As analyses from the initial tests became available the list was refined, some analytes being withdrawn and others added. The revised list is presented as Table 1. (Originally Tables 1.1a, 1.1b and 1.1c from Volume 2, Test Development of the three volumes describing the Bang Box Test Series.)

The U.S. Environmental Protection Agency (U.S. EPA) provided technical guidance and support during the planning of tests and execution phases of the entire project.

TABLE 1

AMCCOM TARGET ANALYTES

Carbon Monoxide	2-Methylnaphthalene
Carbon dioxide	Naphthalane
Ozone	Pyrene
Nitrogen oxides (NO, NO_2, NO_3)	1-Methylnaphthalene
Sulfur dioxide	Biphenyl
Hydrogen cyanide	Phenanthrene
Hydrogen chloride	Benz[c]acridine
Total Suspended particulate	Dibenzofuran
PM_{10} particulate	1,6-Dinitropyrene
C_{10} to C_{10} hydrocarbons	2-Nitronaphthalene
2,4-Dinitrotoluene	1-Nitropyrene
2,6-Dinitrotoluene	4-Nitrosodiphenylamine
4-Nitrophenol	2-Nitrodiphenylamine
Phenol	4-Nitrodiphenylamine
Toluene	N-Nitrosodiphenylamine
Benzene	Polychlorinated dibenzo-dioxins
2,4,6-Trinitrotoluene	Polychlorinated dibenzo-furans
1,3,5-Trinitrobenzene	Diphenylamine
Resorcinol	Isophorone diisocyanate
Salicylic acid	2,5-Diphenyloxazole
Nitroglycerine	1,1,3-Trimethyl-3-phenylindane
Triacetin	Antimony
Di-n-propyl adipate	Arsenic
Phenyl disodecyl phosphite	Barium
Dioctyl sebacate	Cadmium
2,2 Methylene bis-(4 methyl-6-t-butylphenol)	Chromium
5-Ethyl-1,3-digly-cidyl-5-methyl hydantoin diepoxide	Lead
Diethylenetriamine	Beryllium
Benz[a]anthracene	Mercury
Benzo[a]pyrene	Nickel
2-Napthylamine	Fluoride ion
Diobenz[a,h]anthracene	Nitrate ion

Preliminary Test Development

From November 28, 1988 to February 16, 1989 a series of trials was conducted at Sandia National Laboratories (SNL, Albuquerque) in a 1000 m^3 hemisphere constructed of a plasticized fabric which could stretch to accommodate small detonations. This facility, known as the "Bang Box", was fitted with instruments and equipment suggested during the symposium and selected by the TSC. The initial days of testing (December 1, 1988 to December 7, 1988) consisted of testing to establish that the atmosphere within the bang box was homogeneous and established a method to evaluate the bang box volume using SF_6 as a tracer gas. The testing established that the atmosphere was indeed homogeneous after a short period of mixing with fans. The volume of the bang box established with the tracer gas was approximately the volume estimated knowing the diameter and assuming that the box was a perfect hemisphere. Nevertheless all results utilized the volume estimated with the tracer gas since the volume could change appreciably. Preliminary testing also involved a TNT detonation on December 7, 1988 to allow assessment of the monitoring and sampling equipment.

Bang Box Trials

Trials were conducted during the period from January 31, 1989 to February 16, 1989. Three TNT detonations, one double-based propellant burn and one composite propellant burn were completed. The number of tests completed and the number of sampling and analytical techniques evaluated were adequate to allow assessments for the development of sampling and analytical techniques for future testing. These tests showed that the bang box, as a fully enclosed and characterized structure, was sufficiently large to support full combustion processes and permit sampling of emissions from a cloud of known volume.

Field Tests

In June, 1989 AMCCOM initiated a two-year-long series of three large scale OB/OD field tests which included detonations with explosive charges up to 2,030 lbs. and burns using up to 7,040 lbs of propellants in a manner corresponding to normal treatment procedures. These produced large plumes which were sampled by the equipment and instruments that had proven satisfactory during bang box testing. For purposes of the field tests these instruments were mounted aboard an airplane. Project scientists followed the quality control, assay and analytical procedures developed during the earlier bang box tests.

Highlights of the testing (bang box plus field tests) include a new generation of instruments capable of identifying and quantifying difficult compounds at the parts per trillion (ppt) or nonagram (ng) level; and the ability to capture a representative sample from a nonhomogeneous cloud (by using the carbon balance method rather than relying on the traditional, but often inaccurate, cloud volume method). In addition, highlights included formation of a team of experts, the TSC, and participation of the U.S. EPA in a quality assurance capacity throughout the planning, testing and assay. Undoubtedly the greatest singular achievement was establishing a relationship between bang box testing and field testing thus permitting the more efficient bang box testing to replace the time-consuming and expensive field testing.

U.S. Air Force Bang Box Tests

The U.S. Air Force Air Combat Command (USAFACC) sponsored testing of selected munitions in a series of bang box tests conducted at Dugway Proving Grounds during February, 1993. This series of tests used protocols and techniques developed during the AMCCOM tests. Testing included four munitions prepared for testing in a manner paralleling open-air treatment procedures followed by the USAF at its treatment sites. Samples were collected using high volume samplers and personal samplers.

High volume samples were analyzed both by SFC/MS and GC/MS (using EPA method 8270) methods and the personal samples were analyzed by GC/MS - 8270. Target analytes were essentially the same as those used in the earlier AMCCOM tests.

1.3 AMCCOM Study

1.3.1 Sandia National Laboratory (SNL) Bang Box Tests

The tests in the SNL bang box conducted from January 31, 1989 to February 16, 1989 utilized TNT for the explosive tests and both double based and composite propellants for the burn tests. TNT, (0.5 lb blocks), was chosen for the explosive to provide a worst case scenario, that is an explosive expected to produce relatively large quantities of pollutants for a given source mass. TNT has the potential to generate relatively large quantities of Products of Incomplete Combustion (PICs) due to its 74 percent negative oxygen balance. Oxygen balance is a measure of the quantity of oxygen needed per unit of explosive to completely convert carbon, hydrogen, and nitrogen to stable oxides. This means that for each 100 grams of TNT, additional oxygen (over 100 grams) must be added to convert the C, H, and N in the TNT to stable oxides (CO_2, H_2O and NO_2). Other common explosives have lower oxygen deficiencies. For example:

nitrocellulose	-38.7
nitroglycerine	+3.5
nitroguanidine	-30.8
ammonium picrate	-52.0
HMX	-21.6
RDX	-21.6
tetryl	-47.4

Therefore, of the above explosives, only nitroglycerine has sufficient oxygen in the molecule to oxidize all C, H, and N in the molecule to stable gases. TNT, being the most oxygen deficient has the greatest tendency to produce PICs and also has the greatest tendency to have the parent compound emitted from the explosion. Expressed in another way, the TNT molecule has only enough oxygen to convert 26 percent of the carbon to CO_2 (and hydrogen to H_2O and nitrogen to NO_2). Secondary combustion which occurs by entrainment of oxygen from the ambient air into the detonation fireball is necessary for the majority (74 percent) of the combustion that occurs. The efficiency of secondary combustion is less for TNT than for any of the other common explosives.

Nevertheless, all emission factors developed during this testing indicate destruction efficiencies far above 99.99 percent. The overall EF for TNT from the combined tests (AMCCOM and USAFACC), is 2.7 E-6, which indicates a DRE of 99.9997 percent. The highest average EF, obtained in the Air Force block TNT tests was 8.2 E-6. This is equivalent to a DRE of 99.9992 percent. Within that test the highest single result was a EF of 1.02 E-5, which is equivalent to a DRE of 99.999 percent. A DRE of only 99.99 percent would have resulted in an EF of 1.0E-4. In addition generally the bang box tests resulted in higher EFs (therefore lower DREs) than the field tests conducted with far larger amounts of explosives.

The quantity selected was known to ensure a detonation of less-than-maximum efficiency, therefore tending to potentially overestimate PICs. Detonators consisted of pentaerythritol tetranitrate and RDX. The double base propellant consisted primarily of nitrocellulose (51 percent) and nitroglycerine (39 percent). The composite propellant consisted primarily of ammonium perchlorate (85 percent) and hydroxyl-terminated polybutadiene (8 percent). Both propellants had "small amounts of additional

chemicals for purposes such as stability, burning rate modification, physical property enhancement or as a processing aid". (Volume 2, pp 1-5 to 1-6 of the January 1992 report on the AMCCOM tests.) The "additional chemicals" in the double based propellant consisted of triacetin (2.7 percent), di-n-propyl adipate (1.6 percent), 2-nitrodiphenylamine (2.0 percent), lead salicylate (1.5 percent), lead resorcylate (0.5 percent), copper salicylate (2.0 percent), and Candelilla wax (0.1 percent). The "additional chemicals" in the composite propellant included dioctylsebacate (4.5 percent), aluminum oxide (1.0 percent), isophorone diisocyanate (0.6 percent), and smaller amounts of 5-ethyl-1,3 diglycidyl-5-methyl hydantoin diepoxide (0.3 percent), 2,2'-methylene bis (4-methyl-6-t-butyl phenol) (0.2 percent), phenyl diisodecylphosphite (0.2 percent) and diethylenetriamine (0.08 percent).

Complete composition data for propellants is given in Volume I of the Field Studies (Pages 3-37 to 3-47). TNT detonation tests were conducted on January 31, 1989, February 2, 1989, and February 6, 1989. The double base propellant burn test was conducted on February 9, 1989 and the composite propellant burn test was conducted on February 16, 1989.

Several additional tests were conducted during this time frame that are not included in the determination of emission factors. For example a foam-attenuated TNT detonation was conducted on February 13, 1989 to assess the ability of commercially available firefighting foam to serve as a surrogate for soil as a blast mitigant in chamber detonation trials. Data collection was limited to gases and volatile organics. In addition a multi detonation TNT test was conducted on February 8, 1989 to evaluate the collection of a sufficient sample of detonation emissions to facilitate detection of very low levels of trace/exotic organic detonation products. The limited data available from these two tests and a OD trial conducted on February 15, 1989, are not included in emission factor data presented in the AMCCOM reports or in this report.

Generally, sampling and analyses were conducted by several techniques to allow evaluation of each technique. Some sampling techniques were unsuccessful (e.g. the CO real time sampling instrument). Comparison of the supercritical fluid chromatography (SFC)/mass spectrometry and gas chromatographic (GC)/mass spectrometry indicated that either is sufficiently sensitive as an analysis technique to detect and quantify semivolatile organic target analytes. SFC is superior for some of the less thermally stable species (e.g. nitrosamines and some nitro compounds).

Appendices 2-9 and 2-10 contain emission factor data where available for all chemicals considered. Included in these appendices are all of the chemicals considered (from Appendix 2-7) and all AMCCOM/U.S. FACC test data. Tables 2 and 3 contain emission factors (lbs/lb) for chemicals of concern in the Health Risk Assessment for OB and OD respectively. These tables contain data from both AMCCOM and USAFACC testing. Commentary on the data and methods of averaging is presented in section 2.2.4.5.

Foam Attenuation Study

Use of firefighting foam in place of soil as a blast mitigant was tested in the bang box on February 13, 1989. A 221.6 gram TNT block was used and a heavy duty plastic cage was used to contain the foam. The cage, 183 cm in diameter and 92 cm high was filled with foam. Components of the foam were: a glycol ether, a 5-carbon alcohol, xanthan biopolymer, formaldehyde, a sulfonate surfactant and fatty alcohols (C_{12}-C_{14}). The foam attenuated test produced generally lower concentrations of CO_2, and higher concentrations of CO, NO_2, NO, and volatile organics than did the various non-attenuated TNT detonations. The main effects of the foam were mitigation of the blast and noise and reduction of the combustion efficiency as measured by CO_2 to CO ratio. A viscous polymer residue was spread widely about the chamber floor.

TAB :

OPEN BURNING EMISSION FACTORS

COMPOUND	BANGBOX DOUBLE BASE	BANGBOX COMPOSITE	PHASE A TRIPLE BASE	MFGR RESIDUE PHASE B	MFGR. RESIDUE PHASE C	PHASE C M-1	PHASE C M-6	AMCCOM AVERAGE (OB EF)	STANDARD DEVIATION	UPPER 95% CONF. LIMIT	MAX VALUE
1-Nitropyrene	1.0E-08	2.0E-08	1.0E-08	NA	1.0E-08	1.0E-08	1.0E-08	1.2E-08	3.7E-09	1.9E-08	2.0E-08
1,3,5-Trinitrobenzene	NA	NA	1.0E-08	NA	5.3E-09	1.0E-08	1.0E-08	8.8E-09	2.0E-09	1.4E-08	1.0E-08
1,6-Dinitropyrene	1.0E-08	1.0E-08						1.0E-08	0.00	1.0E-08	1.0E-08
2-naphthylamine	1.0E-08	1.0F-08						1.0E-08	0.00	1.0E-08	1.0E-08
2-Nitrodiphenylamine	1.0E-08	NA	1.0E-08	1.0E-08	1.3E-08	1.0E-08	1.0E-08	1.1E-08	1.1E-09	1.3E-08	1.3E-08
2-Nitronaphthalene	5.4E-08	1.3E-08	1.0E-08	3.7E-09	8.3E-08	1.0E-08	1.0E-08	2.6E-08	2.8E-08	8.1E-08	8.3E-08
2,2'-Methylene bis(4-methyl-6-t-butyl phenol)		1.0E-08						1.0E-08	–	–	1.0E-08
2,4-Dinitrotoluene	1.0E-08	1.0E-08	1.0E-08	1.0E-08	1.6E-07	1.2E-09	1.0E-09	2.9E-08	5.4E-08	1.3E-07	1.6E-07
2,4,6-Trinitrotoluene	5.0E-08	1.0E-08	1.0E-08	1.0E-08	6.4E-08	1.0E-08	1.0E-08	2.3E-08	2.2E-08	6.5E-08	6.4E-08
2,6-Dinitrotoluene	1.4E-08	3.7E-08	1.0E-08	1.0E-08	1.4E-07	1.0E-08	7.7E-11	3.2E-08	4.5E-08	1.2E-07	1.4E-07
5-Ethyl-1,3-diglycidyl-5-methylhydantoin diepoxide		1.0E-08						1.0E-08	–	–	1.0E-08
Ammonia	2.0E-05	2.0E-05						2.0E-05	0.00	2.0E-05	2.0E-05
Benzene	1.1E-05	5.7E-06	1.0E-08	1.0E-08	1.6E-05	4.8E-06	1.7E-06	5.6E-06	5.6E-06	1.6E-05	1.6E-05
Benzo[a]pyrene	9.0E-07	1.0E-08	1.0E-08	2.3E-08	8.1E-08	1.0E-08	1.0E-08	1.5E-07	3.1E-07	7.5E-07	9.0E-07
Benz[a]anthracene	1.0E-08	1.0E-08	1.0E-08	3.8E-08	1.4E-07	1.0E-08	1.0E-08	3.3E-08	4.5E-08	1.2E-07	1.4E-07
Benz[c]acridine	1.0E-08	1.0E-08						1.0E-08	–	–	1.0E-08
Carbon monoxide	9.1E-04	2.9E-04	2.5E-05	4.9E-04	7.0E-04	2.5E-04	9.5E-05	3.9E-04	3.0E-04	9.8E-04	9.1E-04
Dibenzofurans	2.6E-07	2.8E-07	1.0E-08	2.6E-07	1.2E-04	1.0E-08	1.0E-08	1.7E-05	4.2E-05	9.9E-05	1.2E-04
Dibenz[a,h]anthracene	1.0E-08	1.0E-08						1.0E-08	0.00	1.0E-08	1.0E-08
Diethylenetriamine		1.0E-08						1.0E-08	–	–	1.0E-08
Diethyl phthalate					1.0E-08			1.0E-08	–	–	1.0E-08
Di-n-propyladipate	1.0E-08							1.0E-08	–	–	1.0E-08
Dioctylsebacate		1.0E-08						1.0E-08	–	–	1.0E-08
Diphenylamine	1.0E-08	1.0E-08	1.0E-08	2.0E-08	3.1E-07	1.1E-10	2.6E-11	5.1E-08	1.1E-07	2.6E-07	3.1E-07
Hydrogen cyanide	2.0E-05	2.0E-05						2.0E-05	0.00	2.0E-05	2.0E-05
Isophoronedi-isocyanate		1.0E-08						1.0E-08	–	–	1.0E-08
Methane	6.7E-05	2.0E-05	bd	bd		7.5E-04	8.0E-03				8.0E-03
Naphthalene	1.0E-08	1.4E-06	1.0E-08	1.5E-06	5.4E-07	1.9E-08	7.5E-08	5.1E-07	6.2E-07	1.7E-06	1.5E-06
Nitric oxide	1.4E-04	3.0E-03	5.2E-03	2.8E-03	2.6E-03	1.2E-03	2.4E-03	2.5E-03	1.5E-03	5.3E-03	5.2E-03
Nitrogen dioxide	8.8E-04	6.1E-04	2.1E-03	5.1E-04	1.5E-04	4.7E-04	5.2E-04	7.5E-04	5.9E-04	1.9E-03	2.1E-03
Nitroglycerin	1.0E-08				1.0E-08			1.0E-08	0.00	1.0E-08	1.0E-08
N-Nitrosodiphenylamine	1.5E-06	3.5E-08	1.0E-08	1.9E-08	2.7E-08	1.0E-08	1.4E-10	2.3E-07	5.2E-07	1.2E-06	1.5E-06
Nitrophenol	6.9E-07	4.1E-07	1.0E-08	1.0E-08	NA	NA	NA	2.8E-07	2.9E-07	2.1E-06	6.9E-07
Particulates (PM-10)		1.0E-04	6.9E-03	1.1E-02	2.0E-02	1.6E-02	1.0E-02	1.1E-02	6.4E-03	2.8E-02	2.0E-02
Phenol	4.4E-06	3.8E-06	1.0E-08	8.0E-06	NA	3.4E-09	1.5E-09	2.7E-06	3.0E-06	8.7E-06	8.0E-06
Phenyldiisodecylphosphite		1.0E-08						1.0E-08	–	–	1.0E-08
Pyrene	NA	NA	1.0E-08	7.1E-08	3.2E-07	1.0E-08	1.0E-08	8.4E-08	1.2E-07	3.4E-07	3.2E-07
Resorcinol	1.0E-08							1.0E-08	–	–	1.0E-08
Salicylic acid	1.0E-08							1.0E-08	–	–	1.0E-08
Sulfur dioxide	3.6E-04	1.4E-04						2.5E-04	1.1E-04	1.7E-03	3.6E-04
TNMHC	1.6E-04	3.3E-04	1.5E-06	4.5E-05	5.6E-04	4.6E-04	1.3E-05	2.2E-04	2.1E-04	6.3E-04	5.6E-04
Triacetin	1.0E-08							1.0E-08	–	–	1.0E-08

TABLE 2-6

OPEN DETONATION EMISSION FACTORS

Date: 6/1/94

SIERRA COMPOUND	BLOCK TNT	20mm HEI	40mm HE	MINE M18A1	ADAPTER BOOSTER	TNT BANG BOX	TNT SURFACE DET PHASE A	TNT SURFACE DET PHASE B	TNT SURFACE DET PHASE C	PHASE C SUFF DET COMP B	PHASE C SUFF DET EXP D	PHASE C SUFF DET RDX	TEST AVERAGE	STANDARD DEVIATION	UPPER 95% CONFIDENCE LIMIT	MAX VALUE
1-Nitropyrene	ID					1.0E-08	1.0E-08	3.9E-08	1.0E-08	5.6E-08	1.1E-08	5.0E-08	2.7E-08	1.9E-08	6.4E-08	5.6E-08
1,3-Butadiene	1.8E-06	3.7E-06	1.6E-06	2.8E-06	2.3E-05								6.6E-06	8.3E-06	2.4E-05	2.3E-05
1,3,5-Trinitrobenzene	1.5E-06	3.7E-07	7.3E-08	4.5E-08	4.2E-09	4.5E-08	1.0E-08	1.0E-08	1.0E-08	5.9E-08	1.6E-08	4.4E-08	1.6E-07	4.1E-07	9.1E-07	1.5E-06
1,4-Dichlorobenzene	2.5E-07	2.5E-07	2.5E-07	2.5E-07	3.0E-07								2.6E-07	2.0E-08	3.0E-07	3.0E-07
2-Methyl naphthalene	1.4E-07	1.6E-07	1.4E-07	1.5E-06	3.6E-07	3.5E-08	1.0E-08						6.3E-07	1.2E-06	3.1E-06	3.5E-06
2-Methylphenol	5.2E-07	5.2E-07	5.2E-07	5.2E-07	1.0E-06								6.2E-07	1.9E-07	1.0E-06	1.0E-06
2-Nitrodiphenylamine	7.3E-09	4.2E-07	1.7E-08	7.3E-09	7.3E-09	NA	1.0E-08	NA	1.0E-08	7.2E-08	5.8E-08	3.4E-08	6.4E-08	1.2E-07	2.9E-07	4.2E-07
2-Nitronaphthalene	1.2E-09	2.7E-09	1.2E-09	1.2E-09	1.2E-09	1.6E-07	6.0E-08	2.7E-07	1.0E-08	6.6E-08	4.3E-08	4.9E-08	5.6E-08	7.9E-08	2.0E-07	2.7E-07
2,4-Dinitrotoluene	8.7E-08	2.4E-06	2.1E-07	4.3E-08	4.3E-08	1.7E-07	1.5E-07	8.4E-06	1.0E-08	4.5E-07	5.9E-07	2.1E-07	1.1E-06	2.3E-06	5.2E-06	8.4E-06
2,4,6-Trinitrotoluene	6.2E-08	3.2E-06	3.2E-06	5.5E-08	3.4E-06	6.2E-07	2.2E-07	1.5E-07	6.0E-08	2.5E-07	4.4E-08	9.6E-08	1.6E-06	2.6E-06	6.4E-06	8.2E-06
2,6-Dinitrotoluene	2.5E-09	7.2E-08	2.5E-09	2.5E-09	2.5E-09	1.4E-07	1.9E-08	7.1E-06	1.0E-08	2.4E-08	8.0E-08	4.1E-08	6.2E-07	2.0E-06	4.1E-06	7.1E-06
4-Nitrophenol						3.4E-07	1.0E-08						1.6E-07	1.7E-07	1.2E-06	3.4E-07
Acenaphthylene	1.3E-07	1.3E-07	1.3E-07	3.0E-07	5.9E-07								2.6E-07	1.6E-07	6.4E-07	5.9E-07
Acetophenone	1.5E-07	1.4E-07	1.4E-07	2.0E-07	1.4E-07								1.5E-07	2.3E-08	2.0E-07	2.0E-07
alpha,alpha-Dimethylphenethylamine					9.9E-07								9.9E-07			9.9E-07
Ammonia						2.9E-04							2.9E-04			2.9E-04
Anthracene	1.3E-07	1.3E-07	1.3E-07	2.6E-07	1.3E-07								1.6E-07	5.2E-08	2.7E-07	2.6E-07
Aromatics (VOs, including benzene)	1.6E-05	1.5E-04	1.6E-05	3.1E-03	3.6E-04								7.2E-04	1.2E-03	3.2E-03	3.1E-03
Benzene	4.2E-06	8.3E-05	4.2E-06	8.2E-04	1.2E-04	2.4E-06	9.4E-05	9.3E-05	1.0E-04	6.2E-05	1.1E-04	6.9E-05	1.3E-04	2.1E-04	5.1E-04	8.2E-04
Benzo[a]pyrene	1.3E-08	1.3E-08	1.3E-08	1.2E-07	1.3E-08	3.6E-07	1.0E-08	2.4E-07	1.0E-08	1.4E-08	3.6E-08	1.4E-07	6.2E-08	1.1E-07	2.6E-07	3.6E-07
Benzo[b]fluoranthene				6.0E-07									6.0E-07			6.0E-07
Benzyl alcohol	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.2E-07							1.1E-07	3.7E-09	1.2E-07	1.2E-07
Benzo[k]fluoranthene				4.8E-07									4.8E-07			4.8E-07
Benz[a]anthracene	4.3E-09	4.3E-09	6.6E-09	1.3E-07	2.9E-08	1.0E-08	2.2E-09	1.6E-07	1.0E-07	7.4E-09	1.9E-08	9.3E-08	4.7E-08	5.5E-08	1.5E-07	1.6E-07
Butyl benzyl phthalate	2.1E-07	1.6E-07	6.2E-07	4.6E-07	1.1E-06								5.1E-07	3.4E-07	1.2E-06	1.1E-06
Carbon monoxide						4.9E-03	6.1E-02	4.2E-02	4.9E-02	3.1E-02	5.3E-02	3.1E-02	3.9E-02	1.7E-02	7.2E-02	6.1E-02
Chrysene				2.3E-07									2.3E-07			2.3E-07
Dibenzofurans	1.5E-08	9.2E-08	3.1E-08	9.6E-08	1.6E-07	1.5E-07	1.0E-08	8.5E-08	1.6E-07	1.0E-08	1.1E-07	2.0E-08	2.4E-07	5.3E-07	1.2E-06	2.0E-06
Dibenz[a,h]anthracene						4.3E-07							4.3E-07			4.3E-07
Di-n-butyl phthalate	4.4E-08	3.6E-05	2.0E-06	6.6E-06	4.3E-06								9.8E-06	1.3E-05	3.6E-05	3.6E-05
Diethyl phthalate	1.9E-07	1.4E-07	5.0E-07	2.0E-07	3.2E-07								2.7E-07	1.3E-07	5.5E-07	5.0E-07
Dimethyl phthalate	8.6E-08	2.5E-07	4.1E-07	1.6E-07	2.7E-07								2.4E-07	1.1E-07	4.7E-07	4.1E-07
Di-n-octyl phthalate	2.7E-07	9.5E-07	1.5E-06	5.1E-06	5.0E-07								1.7E-06	1.8E-06	5.4E-06	5.1E-06
Diphenylamine	1.4E-08	1.3E-08	1.3E-08	2.3E-08	1.4E-08	1.0E-08	NA	7.7E-09	1.7E-07	6.6E-08	1.9E-08	3.1E-07	6.0E-08	9.1E-08	2.3E-07	3.1E-07
Di(2-ethylhexyl)phthalate	1.0E-06	1.1E-06	2.9E-06	2.2E-06	2.4E-06								1.9E-06	7.5E-07	3.5E-06	2.9E-06
Ethyl benzene	4.8E-07	3.4E-06	4.8E-07	3.8E-05	9.0E-06								1.0E-05	1.4E-05	4.1E-05	3.8E-05
Fluoranthene	2.2E-07	2.2E-07	2.2E-07	1.1E-06	3.3E-07								4.2E-07	3.4E-07	1.2E-06	1.1E-06
Fluorene	2.2E-07	2.2E-07	2.2E-07	2.2E-07	3.5E-07								2.5E-07	5.2E-08	3.6E-07	3.5E-07
Hexane	9.6E-07	2.5E-06	9.6E-07	3.0E-05	5.6E-06								8.0E-06	1.1E-05	3.2E-05	3.0E-05
HMX	4.0E-08	1.2E-06	1.1E-05	7.5E-06	1.3E-04								3.0E-05	5.0E-05	1.4E-04	1.3E-04
Hydrogen cyanide	9.7E-04	4.5E-03	3.4E-03	2.3E-03	2.4E-03	4.0E-05							2.3E-03	1.5E-03	5.2E-03	4.5E-03
Methane	5.5E-04	2.6E-03	5.1E-05	5.8E-03	7.0E-03	2.5E-05	1.5E-03	1.2E-03	1.5E-03	6.0E-04	2.4E-03	2.0E-04	2.0E-03	2.2E-03	5.9E-03	7.0E-03
Naphthalene	1.3E-07	1.4E-07	8.1E-08	7.0E-08	1.7E-07	2.6E-05	1.0E-08	3.7E-08	2.0E-08	4.2E-07	6.3E-07	2.0E-07	3.0E-06	7.6E-06	1.7E-05	2.6E-05
Nitric oxide						1.1E-02	7.0E-04	1.4E-03	1.4E-03	8.0E-04	9.0E-04	9.0E-04	2.4E-03	3.5E-03	9.2E-03	1.1E-02
Nitrogen dioxide						5.6E-04	3.6E-03	1.1E-03	1.4E-03	1.0E-03	1.1E-03	6.0E-04	1.3E-03	9.6E-04	3.2E-03	3.6E-03
N-Nitrosodiethylamine		1.2E-07											1.2E-07			1.2E-07
N-Nitrosodiphenylamine	2.8E-08	4.5E-06	5.7E-08	2.8E-08	4.0E-08	2.0E-07	1.0E-08	4.4E-09	1.0E-08	3.6E-08	5.6E-08	1.0E-08	4.2E-07	1.2E-06	2.6E-06	4.5E-06
Olefins (VOs)	6.2E-05	4.2E-04	1.3E-04	1.3E-03	1.4E-03								6.6E-04	5.8E-04	1.9E-03	1.4E-03
Parafins (VOs)	7.2E-05	1.2E-04	7.2E-05	7.2E-05	6.7E-05								6.5E-05	1.9E-05	1.3E-04	1.2E-04
Particulates (PM-10)	7.3E-02	2.4E-01	6.3E-01	2.3E-01	2.6E-01	1.7E-02							2.4E-01	1.9E-01	6.3E-01	6.3E-01
Phenanthrene	3.3E-08	2.7E-07	2.4E-07	2.1E-06	1.1E-06	2.0E-08	1.0E-08						5.4E-07	7.3E-07	2.0E-06	2.1E-06
Phenol	1.6E-07	1.7E-07	1.3E-07	7.1E-07	1.3E-07	9.9E-06	1.0E-08	5.2E-06	1.0E-08				1.8E-06	3.3E-06	7.9E-06	9.9E-06
Picric acid											5.0E-08		5.0E-08			5.0E-08
Pyrene	9.0E-08	4.3E-07	9.0E-08	2.0E-06	4.6E-07	3.2E-08	1.0E-08	NA	2.2E-07	2.1E-07	1.8E-07	2.2E-07	3.6E-07	5.4E-07	1.3E-06	2.0E-06
RDX	1.2E-06	1.6E-05	5.0E-05	9.9E-06	2.4E-04					1.0E-08		2.1E-06	4.5E-05	8.0E-05	2.0E-04	2.4E-04
Styrene	1.1E-04	1.1E-04	1.1E-04	1.7E-03	1.1E-04								4.3E-04	6.4E-04	1.8E-03	1.7E-03
Sulfur dioxide						2.2E-04							2.2E-04			2.2E-04
TNMHC	9.9E-04	9.9E-04	2.7E-04	4.8E-03	1.9E-03	5.7E-05	1.4E-03	1.9E-03	2.1E-03	1.2E-03	2.0E-03	1.3E-03	1.6E-03	1.2E-03	3.7E-03	4.9E-03
TO-12 (TOT ORGANICS,C2-C15)	3.0E-04	1.7E-03	4.3E-04	7.5E-03	2.3E-03								2.5E-03	2.6E-03	8.1E-03	7.5E-03
Toluene	5.3E-06	2.2E-05	5.3E-06	2.5E-04	5.1E-05								6.7E-05	9.3E-05	2.7E-04	2.5E-04
Xylenes (isomers and mixture)	3.1E-06	1.7E-05	3.1E-06	2.2E-04	2.6E-05								5.4E-05	8.3E-05	2.3E-04	2.2E-04

1.3.2 Field Test Series

The AMCCOM field tests were conducted in three phases.

- Phase A, conducted from June 13, 1989 to June 21, 1989, included TNT surface detonations and propellant burns with a triple base propellant. The M30 propellant consisted of nitrocellulose (28 percent), nitroglycerine (22.5 percent), nitroguanidine (47.7 percent), ethyl centralite (1.5 percent) with minor amounts of graphite and volatiles (Volume 1, p 3-42 of the January 1992 report on the AMCCOM field studies).

- Phase B, conducted from October 16, 1989 to October 31, 1989 included TNT detonations and propellant burns of manufacturing residue. A variety of propellant types was used during the phase B test burns. The purpose of mingling propellant and inhibitor materials was to represent waste propellants generated at manufacturing facilities. Three different combinations of six different propellants with cellulose acetate inhibitor were burned. (Volume 2, p 3-44 of the January 1992 report on the AMCCOM studies).

- Phase C was conducted from August 7, 1990 to September 18, 1990. Surface detonations conducted during Phase C included detonations of TNT, Explosive D, Composition B and RDX. Propellant burns conducted during Phase C included propellants M-1 and M-6 and manufacturing residue. Explosive D consisted of 99.9 percent ammonium picrate with minor amounts of sulfates, ash and chloroform insoluble and water insoluble impurities. (Vol 2, p 3-38 of the January 1992 report on the AMCCOM studies). Composition B consisted of RDX (59.5 percent), TNT (39.5 percent) and Composition D-2 Wax (1 percent) (Vol. 2, p 3-37 of the January 1992 report on the AMCCOM studies). The RDX explosive, PBXN-6, consisted of RDX (95 percent) and Viton A (5 percent) (Vol.2, p 3-39 of the January 1992 report on the AMCCOM studies). The manufacturing residue consisted of propellants in the form of rolls 4 inches wide by 15 inches diameter by 0.08 inches thick which would have been extruded if its manufacturing process had not been interrupted. Residues were mixtures of two different propellants, both of which were primarily nitrocellulose and nitroglycerine. (Vol 2, pp 3-42 and 3-47 of the January 1992 report on the AMCCOM studies). Propellant M-1 consisted of nitrocellulose (85 percent), dinitrotoluene (10 percent), dibutylphthalate (5 percent) and minor amounts of diphenylamine, potassium sulfate, solvents, and water. (Vol. 2, p 3-40 of the January 1992 report on the AMCCOM studies). Propellant M-6 consisted of Nitrocellulose (87.7 percent) dinitrotoluene (9.7 percent) dibutylphthalate (2.5 percent) and minor amounts of diphenylamine, potassium sulfate, water and solvents. (Vol.2, p 3-41 of the January 1992 report on the AMCCOM studies).

1.3.3 Suspended versus Surface Detonations

During Phases B and C of the Field Studies, several detonations of TNT were conducted with the TNT suspended above the ground surface. Emission factors were calculated from the suspended tests conducted and compared with the EFs calculated from all three phases of detonations conducted at surface level. Table 4 summarizes these comparisons.

TABLE 4
EMISSION FACTORS
SURFACE DETONATIONS VERSUS
SUSPENDED DETONATIONS

Chemical	Emission Factor (g/g)	
	Surface Detonations	Suspended Detonations
carbon monoxide	0.051	0.0071
nitric oxide	0.0012	0.0024
nitrogen dioxide	0.0020	0.0016
methane	0.0014	0.00078
TNMHCs	0.0018	0.0026
benzene	0.000096	0.000033
2,4,6-trinitrotoluene	143E-9	93E-9
naphthalene	2100E-9	906E-9
benz(a)anthracene	87E-9	193E-9
dibenzofuran	88E-9	125E-9
total particulates	1.29	0.25

The data show that the amount of particulate (soil) entrained in the surface detonation is much greater than that from the suspended detonation. The greater amount of CO indicates, as would be expected, that the efficiency of combustion in the surface detonation is less than that of the suspended detonation. The greater amounts of methane, benzene and naphthalene produced in the surface detonations support this premise. However, the smaller amounts of benz(a)anthracene, dibenzofuran and especially the total non-methane hydrocarbons indicate that this less efficient combustion does not produce greater amounts of more complex hydrocarbons. The emission factor for total particulate matter may be extremely variable from test to test (depending on many factors such as the exact position of the plane during the pass through the cloud). Also this will vary to a large degree with the moisture in the soil. It is mentioned on page 4-10 of Volume 1 of the January 1992 report AMCCOM Field Studies that "Ground crews noted very different soil conditions during the various testing phases". In addition, the above calculation of a PM-10 EF, assumes that the carbon concentration of 34.95 mg/m^3 given on page 4-2 is a good estimate for all tests. Considering that the bulk of the carbon is found as CO_2 and that the CO_2 emission factor did not vary substantially from test to test this may be a somewhat reasonable assumption. This assumption is probably the biggest source of error in the calculation of the EF for total particulate matter. In any event it is reasonable to conclude that the EF for total particulate matter is far larger for surface detonations than for suspended detonations due to soil entrainment.

1.4 USAFACC Study

The USAFACC extended the bang box tests in early 1993 to OD of explosives of interest to their treatment operations. The results of this study were presented to U.S. EPA Region VIII in October, 1993.

1.4.1 Dugway Proving Ground Bang Box Testing

A new bang box was constructed at Dugway Proving Grounds (DPG) for this testing, which took place from February 8, 1993 to February 12, 1993. A total of 15 OD tests were completed, three each on four munitions utilized heavily by Air Force locations and three on block TNT. The block TNT testing was performed partly to provide continuity to previous OD testing at SNL. During the planning stages for this testing the DPG project officer maintained frequent contact with the U.S. EPA Region VIII. During the actual testing the U.S. EPA member of the TSC took particular interest in QA/QC measures by observing test operations, visiting supporting laboratories, providing personnel for systems audits and preparing the QA/QC section of the final report.

The USAFACC testing included a three tiered sampling and analysis methodology. Two samples were collected in conventional high volume ambient air samplers. One sample was analyzed by Supercritical Fluid Chromatography/Mass Spectrometric (SFC/MS) procedures and the other by Gas Chromatographic/Mass Spectrometric (GC/MS) procedures, using the EPA method 8270. A third sample was collected by a personal sampler and assayed by GC/MS using EPA method 8270.

The sample subjected to SFC/MS analysis was assayed for the same list of semi-volatile target analytes used in the previous AMCCOM studies. These target analytes are presented in Table 5. SFC/MS analysis was chosen because this had shown advantages over the more conventional GC/MS in detecting less stable species such as the nitrosamines and nitro compounds. The second sample (Hi Vol sampler, GC/MS analysis) was analyzed for a substantial list of about 120 semivolatile organic compounds. This list of target analytes is presented in Table 6. Finally the third sample (PS sampler, GC/MS analysis) was analyzed for a list of about 78 gases and volatile organic compounds. These target analytes are shown in Table 7. The lists were not mutually exclusive, that is some target analytes were included on both the list subjected to SFC/MS analysis and GC/MS analysis. In addition, since semivolatile organic compounds can be detected in the third sample, target analytes from the first two lists were reported for the third sample. This extension of the designed protocol provided data in instances where the higher tiered data were faulty. In addition criteria pollutants, other gases (including HCN and SF_6) were targeted for analysis in each test.

Munitions studied included (1) 20 mm High-Explosive Incendiary (HEI) Cartridge, (2) 40 mm High Explosive (HE) Cartridges, (3) M18A1 Claymore Antipersonnel Mines, and (4) T45E7 Adapter-Boosters, as well as the TNT.

Three 20 mm HEI Cartridges in each test consisted of 10.69 grams of explosive (61 percent RDX, 35 percent aluminum powder and 4 percent wax) with 39.20 grams of WC 870 Propellant (72 to 82 percent nitrocellulose, 8 to 11 percent nitroglycerine with smaller amounts of graphite, potassium nitrate, sodium sulfate, calcium sulfate, diphenylamine, dibutylphthalate, stannic dioxide and volatiles) and 1.29 grams of I-136 incendiary. C4 Explosive Donor Charge (consisting of 91 percent RDX with polyisobutylene and mineral oil) was used in each test in 60 gram amounts. (Volume 1, p 3-7 of the January 1994 Report of USAFACC studies).

Two 40 mm HE Cartridges consisted of 54.5 grams of Composition A-5 Explosive (98 percent RDX with 2 percent stearic acid), 4.64 grams of M2 Propellant (75.55 percent nitrocellulose, 19.95 percent nitroglycerine, with minor amounts of barium nitrate, potassium nitrate, dinitrotoluene, diphenylamine and graphite). The C4 Explosive Donor Charge, 40 grams was also used in each test. (Volume 1, p 3-10 of the January 1994 Report of USAFACC studies).

The nominal composition of the M18A1 Antipersonnel Mine consisted of 227 grams of the C4 Explosive (91 percent RDX, 2 percent Polyisobutylene, and 1 percent Mineral Oil). (Volume 1, p 3-13 of the January 1994 Report of USAFACC studies).

The T45E7 Adapter Booster tested consisted of 177 grams of Tetryl with 10 grams of the C4 Explosive. (Volume 1, p 3-13 of the January 1994 Report of USAFACC studies).

The TNT tests were conducted with 227 grams (0.5 lb) blocks. Three cubical detonation blocks were removed from their cardboard casing and tied together and suspended by monofilament nylon line.

TABLE 5

SEMIVOLATILE ORGANIC COMPOUNDS TARGETED FOR ANALYSIS BY SFC/MS DURING USAFACC TEST

Semivolatile Organic Compounds
2,4-Dinitrotoluene
2,6-Dinitrotoluene
2,4,6-Trinitrotoluene
2-Nitronaphthalene
N-Nitrosodiphenylamine
1,3,5-Trinitrobenzene
2-Nitrodiphenylamine
1-Nitropyrene
Naphthalene
Benz[a]anthracene
Benzo[a]pyrene
Pyrene
Phenol
Dibenzofuran
Diphenylamine
RDX Cyclonitee
HMX Octogen
Tetryl

TABLE 6

SEMIVOLATILE ORGANIC COMPOUNDS FOR ANALYSIS DURING USAFACC TESTING BY GCMS U.S. EPA METHOD 8270

1,2,4,5-Tetrachlorobenzene	4-Chloroaniline	Fluorene
1,2,4-Trichlorobenzene	4-Chlorophenyl phenyl ether	Hexachlorobenzene
1,2-Dichlorobenzene	4-Chloro-3-methylphenol	Hexachlorobutadiene
1,2-Diphenylhydrazine	4-Nitroaniline	Hexachlorocyclopentadiene
1,3,5-Trinitrobenzene	4-Nitrophenol	Hexachloroethane
1,3-Dichlorobenzene	4-Nitroquinoline-1-oxide	Hexachloropropene
1,3-Dinitrobenzene	5-Nitro-o-toluidine	Indeno(1,2,3-cd)pyrene
1,4-Dichlorobenzene	7,12-Dimethylbenz(a)anthracene	Isodrin
1,4-Naphthoquinone	Acenaphthene	Isophorone
1,4-Pheeylenediamine	Acenaphthylene	Isosafrole
1-Naphthylamine	Acetophenone	Methapyrilene
2,3,4,5- or 2,3,4,6-TCPhenol	Aniline	Methyl methanesulfonate
2,3,5,6-Tetrachlorophenol	Anthracene	Naphthalene
2,4,5-Trichlorophenol	Benzo(a)anthracene	Nitrobenzene
2,4,6-Trichlorophenol	Benzo(a)pyrene	N,N-Dimethyl-1-phenethylamine
2,4-Dichlorophenol	Benzo(b)fluoranthene	N-Nitrosodiethylamine
2,4-Dimethylphenol	Benzo(ghi)perylene	N-Nitrosodimethylamine
2,4-Dinitrophenol	Benzo(k)fluoranthene	N-Nitrosodiphenylamine
2,4-Dinitrotoluene	Benzoic Acid	N-Nitrosodi-n-butylamine
2,6-Dichlorophenol	Benzyl alcohol	N-Nitrosodi-n-propylamine
2,6-Dinitrotoluene	bis(2-Chloroethoxy)methane	N-Nitrosomethylethylamine
2-Acetylaminofluorene	bis(2-Chloroethyl)ether	N-Nitrosomorpholine
2-Chloronaphthalene	bis(2-Chloroisopropyl)ether	N-Nitrosopiperidine
2-Chlorophenol	bis(2-Ethylhexyl)phthalate	N-Nitrosopyrrolidine
2-Methylnaphthalene	Butyl benzyl phthalate	O,O,O-triethylphosphorothioate
2-Methylphenol	Carbazole	o-Toluidine
2-Naphthylamine	Chlorobenzilate	Pentachlorobenzene
2-Nitroaniline	Chrysene	Pentachloroethane
2-Nitrophenol	Diallate(cis)	Pentachloronitrobenzene

TABLE 6
SEMIVOLATILE ORGANIC COMPOUNDS FOR ANALYSIS DURING USAFACC TESTING BY GCMS U.S. EPA METHOD 8270
PAGE 2

2-Picoline	Diallate(trans)	Pentachlorophenol
3,3'-Dichlorobenzidine	Dibenz(a,h)anthracene	Phenacetin
3,3'-Dimethylbenzidine	Dibenzofuran	Phenanthrene
4-Methylphenol	Diethyl phthalate	Phenol
3-Chloropropionitrile	Dimethoate	Pronamide
3-Methylcholanthrene	Dimethyl phthalate	Pyrene
3-Nitroaniline	Diphenylamine	Pyridine
4,4'-Methylene-bis-2-chloraniline	Di-n-butyl phthalate	p-(dimethylamine)azobenzene
4,6-Dinitro-2-methylphenol	Di-n-octyl phthalate	Safrole
4-Aminobiphenyl	Ethyl methanesulfonate	Tetraethyl dithiopyrophosphate
4-Bromophenyl phenyl ether	Fluoranthene	Thionazin

TABLE 7

CATEGORIES OF VOLATILE ORGANIC COMPOUNDS ANALYZED BY SFS/MS DURING USAFACC TESTING

	Paraffins	Olefins	Non-Benzene Aromatics
Carbon dioxide	n-Heptane	Ethylene	Toluene
Carbon monoxide	2,4-Dimethylhexane	2-Methyl-1-pentene	1,3,5-Trimethylbenzene
Methane	2-Methylheptane	Propene	n-Propylbenzene
	2-Methylpentane	1-Butene	Styrene
	3-Methylpentane	trans-2-Hexene	i-Propylbenzene
	Ethylchlorohexane	3-Methyl-1-butene	Ethylbenzene
	n-Hexane	Isoprene	o-Xylene
	i-Butane	1,3-Butadiene	m-Xylene + p-Xylene
	Methylcyclopentane	trans-2-Pentene	1,2,4-Trimethylbenzene & sec-Butylbenzene
	n-Butane	cis-2-Butene	Acetylene
	2,4-Dimethylpentane	cis-2-Hexene	Benzene
	2,2-Dimethylpropane	1-Pentene	p-Ethyltoluene
	Cyclohexane	2-Methyl-2-butene	m-Ethyltoluene
	n-Pentane	1-Hexene	o-Ethyltoluene
	2,3-Dimethylpentane	4-Methyl-1-pentene	
	Cyclopenatne	trans-2-butene	
	3-Methylhexane	2-Methyl-2-pentene	
	n-Octane	2-Methyl-1-butene	
	Ethane	2-Pentene	
	2,3-Dimethylhexane	Cyclopentene	
	n-Octane	cis-2-Pentene	
	Ethane	cis-4-Methyl-2-pentene	
	2,3-Dimethylhexane	2,4,4-Trimethyl-1-pentene	
	Methylcyclohexane	2,2,4-Trimethyl-2-pentene	
	2,3,4-Trimethylpentane		
	n-Nonane		
	2,3-Dimethylbutane		
	Propane		

TABLE 7
CATEGORIES OF VOLATILE ORGANIC COMPOUNDS ANALYZED
BY SFS/MS DURING USAFACC TESTING
PAGE 2

	Paraffins	Olefins	Non-Benzene Aromatics
	2,2-Dimethylbutane		
	3-Ethylhexane		
	2,2,3,3-Tetramethylbutane		
	2-Methylhexane		
	2,5-Dimethylhexane		
	2,2-Dimethylheptane		
	2,2,4-Trimethylhexane		
	n-Decane		

PM-10 Results

Compared with results from earlier bang box tests conducted at SNL, the measurements of PM-10 (all particulate matter collected has been assumed to be PM-10) were higher. Even the results from the TNT detonations are higher than the TNT results at SNL by a factor of four, the cause of which is not known at this time. The size of the explosive was essentially the same. A standard blasting cap was used at the Dugway tests whereas SNL used PEEN and RDX detonators. The higher PM-10 results for each of the other explosives tested at Dugway appears related to the amount of casing material involved. No weights are given for these in the reports. Analysis of the toxic metals was conducted during each Air Force test. These appear somewhat constant among the four explosives tested. In each test, however, non-toxic metals such as iron, were either not tested or not reported.

1.4.2 Tentatively Identified Compounds (TICs)

Volume 2-A of the Air Force Bang Box study addresses the many peaks observed during the GC/MS analyses that were not target analytes and not definitely identified. Standard procedure in most laboratories (when the effort is authorized) is to automatically compare the observed mass spectra to a reference library of mass spectral data in an effort to identify the unknown compounds. This comparison is then presented as a list of "tentatively identified compounds" or TICs. Volume 2-A contains several disclaimers for this list of TICs including: "Table II, Appendix D lists retention times and very tentative identifications of compounds detected in the sample extracts that were not Appendix IX target analytes." and also "It should be understood that this data is not very reliable."

Although the TIC data is not useful for establishing EF for any tentatively identified compound, the data can be used in the aggregate to evaluate whether the representativeness of the compounds considered were carried into the risk assessment. For example, it has been determined based on waste constituents and emission data, that halogenated compounds are not of concern. If halogenated compounds had been present it would be probable that there would be several TICs that were halogenated compounds.

Volume 2-A Appendix D, Table 1 categorizes the TICs into families (and groups of families) of organic compounds. The three family groups tabulated are (1) Aliphatics and Derivatives, (2) Benzene Derivatives, and (3) PAHs and Derivatives.

Given the "not very reliable" qualifier already explained, evaluation of this TIC data when considered in the aggregate, tends to confirm that the chemicals of concern in the risk assessment adequately represent the total risk posed by OB, OD, SF, and DF emissions.

1.5 OB/OD Emission Tests Data Summary

1.5.1 Data Summary Techniques

All positive results from the AMCCOM and USAFACC studies (that is all reported results above the detection limit) have been used to assemble this data summary. In some cases it was necessary to use the reported laboratory data where this data was not presented in the body of the various reports. Generally in calculation of test results for the average of a series of tests the AMCCOM study geometric means were used to present averages. This required that any results at or below the detection limit, which were treated as zero, were not included. In the U.S. AFACC study, averages of a series of tests were arithmetic averages. For data summary presented in this HRA, average emission factors were calculated using arithmetic means. Where the result was presented in the AMCCOM report as NA

(usually indicating that an insufficient number of individual test results were obtained so that no meaningful average could be presented or that the parameter was not a target analyte for the particular test) the test was not used in the calculation of the average.

In the AAMCOM reports, a value of 1E-8 was indicated in several tables (e.g. Table 4.3.2; 4.3.7; 4.3.15; Volume 1, Field Test Series) to be a satisfactory detection limit for "most target analytes." Therefore, this was used for a detection limit when needed for semivolatile organics. In the USAFACC reports, no estimate of detection limit was presented. Therefore, where a value was not presented it was assumed that the parameter was found but at a very low level. In these cases it was assumed that the smallest value reported in other tests could be used to approximate the detection limit where needed. In practice the value of 1E-8 for the AAMCOM detection limit or the lowest value reported in other tests for the USAFACC detection limit appears to make little difference in calculation of the averages and the 95 perent upper confidence limit. Invariably the values reported are substantially higher than these estimates.

Where results had been obtained both from AMCCOM and USAFACC testing, an overall average was obtained by giving equal weight to each test. In checking these averages, it must be remembered that a greater number of significant figures were used than presented in the tables.

1.5.2 Open Burning Emission Factor Results

Open burning (OB) emission factors (EF) developed from the AMCCOM testing (bang box and field studies) are shown on the master list in Appendix 2-7. These are also shown in Table 2. The table contains results of the semivolatiles obtained by SFC/MS analysis. This information is obtained from Table 5 in Volume 1 of the Field Test Series report (Appendix 2-12). EFs for analytes found below the detection limit are assumed to be equal to 1.0E-8 lb/lb.

Table 2 also shows EF for four criteria pollutant gases (CO, NO, NO_2, and PM-10) and three volatile target analytes (methane, benzene, and TNMHCs) from seven different tests of propellant burns.

1.5.3 Open Detonation Emission Factor Results

Open Detonation (OD) emission factors (EF) developed in the AMCCOM and/or USAFACC studies are shown in Table 3. Table 3 shows the results for the 16 prime semivolatile organic target analytes. Arithmetic averages were used in each set of tests. In the AMCCOM tests, results below the detection limit were stated in AMCCOM tables as "BD". In these cases the value was incorporated into the average as 1.0E-8 lbs/lb. Where the result was indicated as NA, (i.e. not applicable) the result was not incorporated into the average. In the USAFACC tests it was not certain that a missing result indicated a result below detection or that the analyte was not a target analyte in that test. In calculations of the U.S. AFACC average, a missing result was incorporated into the average as the lowest value reported for that analyte in other tests.

Table 3 shows results for the positive values obtained in either the AMCCOM or USAFACC testing. This table shows all compounds listed in Table 3.10 of Volume 1 of the USAFACC report. The report indicates that these compounds were all tested for by the G/MS analyses from the Hi Vol sampler and the PS sampler. USAFACC results are from the Hi Vol sampling unless indicated.

Table 3 also shows EFs for the energetics that were tested for during the two studies. Both studies contain substantial data on TNT. Both studies used RDX as a target analyte. The USAFACC study used RDX as a target analyte in all tests, whereas the AMCCOM testing analyzed for RDX only in those cases

where the explosive contained RDX. HMX was a target analyte in the USAFACC studies, and Picric Acid was a target analyte in one series of tests during the AMCCOM tests.

Table 3 also shows EFs for the criteria pollutants and volatile organics (including hydrogen cyanide). Not all data is available from each study. For example the criteria pollutant gases, although analyzed in the USAFACC study were not reported. PM-10 was not analyzed for in the AMCCOM field tests. Similarly data on butadiene, paraffins, olefins, aromatics and TO-12 was not available from the AMCCOM reports. Nevertheless, when all the data are used a good estimate of each EF is available.

Tables 2 and 3 summarize all OB and OD results for parameters that had data available. In these tables each test result is shown along with the average of all tests (using 1E-8 as an estimate of the detection limit for AMCCOM tests and the lowest reported number for USAFACC tests). In addition the standard deviation and 95% upper confidence limit are tabulated along with the maximum test result. In these tables the standard deviation and upper confidence limit are calculated according to U.S. EPA publication 9285.7-081, Supplemental Guidance to RAGS: Calculating the Concentration Term. This procedure assumes a normal distribution and the equation for the upper confidence limit (UCL) is:

$$UCL = x + t(s/n^{0.5}) \text{ where}$$

x = mean of the untransformed data
s = standard deviation of the untransformed data
t = Student-t statistic (from Appendix IV, 40CFR264)
n = number of samples

APPENDIX D-2

HIGH-EXPLOSIVE FIELD TESTS - EXPLOSION PHENOMENA AND ENVIRONMENTAL IMPACTS (DNA, OCTOBER 1981) - OD CRATER VOLUME -

AD/A135 737

HIGH-EXPLOSIVE FIELD TESTS - EXPLOSION PHENOMENA AND ENVIRONMENTAL IMPACTS

Kaman Tempo
Santa Barbara, CA

Oct 81

U.S. Department of Commerce
National Technical Information Service
NTIS

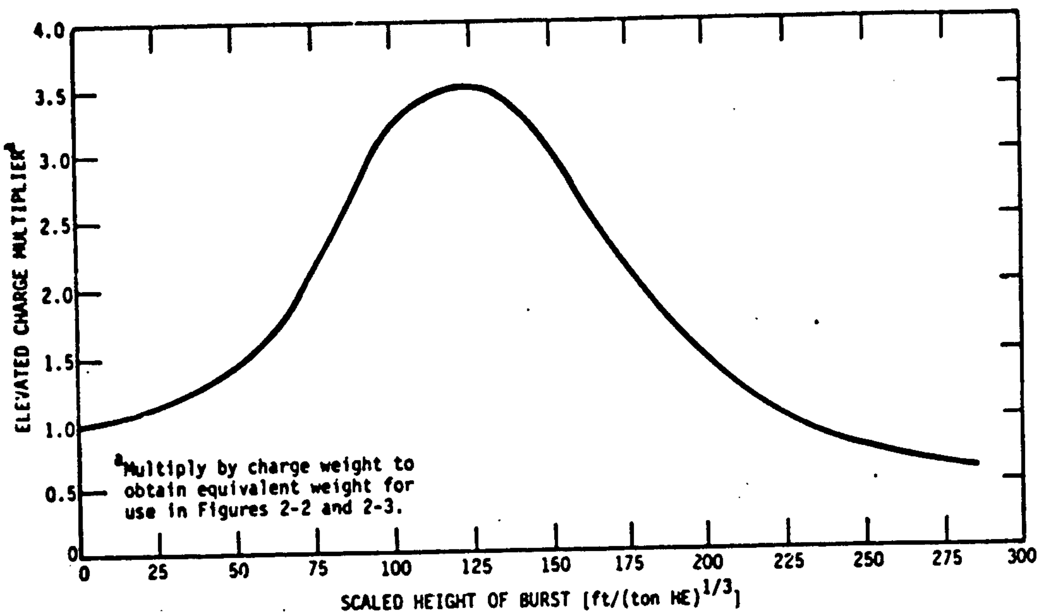


Figure 2-4. Height-of-burst multiplying factor. (Adapted from Reference 1)

CRATERS

The dimensions of an explosion-produced ground crater depend on a number of factors but are most strongly influenced by the TNT-equivalent weight of the charge, the placement of the charge relative to the ground surface, and the type of soil or rock and its water content. Crater dimensions are best predicted based on any previous explosions at the same test site, but even in this case crater dimensions can vary considerably under seemingly identical conditions. For example, PRE-DICE THROW I and II were both 100-ton TNT-equivalent HE charges at virtually the same location; yet, one crater was considerably shallower and wider than the other.

Figure 2-5 shows data for crater volumes from 256-pound spheres of TNT exploded on and below the ground surface in alluvium soils at two different sites.* As can be seen, crater volume increases with depth of charge burial to a maximum volume at the optimum depth for cratering, which is proportional to the charge weight and is about 10 feet for these 256-pound charges. Below the optimum cratering depth, the explosion becomes more

* Negative values of height-of-burst are used here for explosive charges whose center of gravity is below the ground surface. The absolute values of these numbers are often referred to as depths-of-burst.

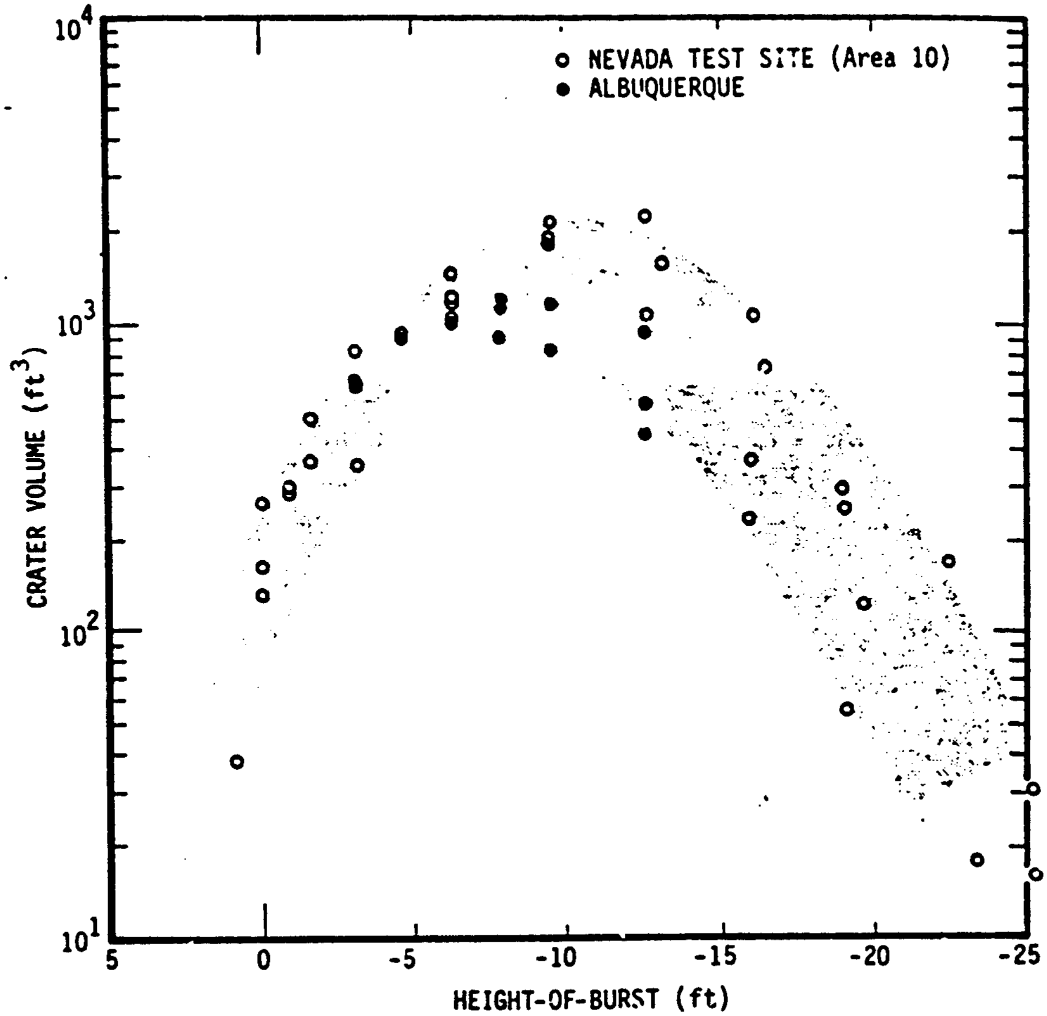


Figure 2-5. Crater volumes from 256-pound spheres of TNT in dry alluvium. (Source: Reference 9)

contained and crater volume decreases. If the charge is buried deep enough, it will be fully contained and no crater will be visible. Note that for relatively shallow-buried charges (those above the optimum cratering depth), the scatter of data indicates that crater volumes may differ by a factor of 2 or 3 for this specific situation, primarily from geological uncertainties. A different geological condition would result in a different set of data.

Table 2-2 lists TNT-equivalency cratering factors for some of the more common explosives, e.g., from a cratering standpoint 1.23 tons of TNT are equivalent to 1 ton of Pentolite. It must be stressed that the factors in Table 2-2 are based on very little data and data trends can be obscured by geological influences.

Table 2-2. TNT-equivalent weights of explosives for ground cratering. (Source: Reference 10)

Explosive Type	TNT-Equivalent Weight Factor[a]
TNT	1.00
Amatol	0.94
Dynamite (40%)	0.68
Pentolite	1.23
C-4, C-3	1.34
Ammonium Nitrate	1.00
Nitromethane	1.10

[a]To determine the TNT-equivalent weight of an explosive, multiply the weight of the explosive by the equivalent weight factor, e.g., 1 ton of Pentolite will produce a crater approximately equivalent to one that would result from 1.23 tons of TNT.

The shape of the explosive charge also has some influence on crater size for explosions on the ground surface. In general, hemispherical, or similar shaped, charges produce somewhat larger craters than do spherical charges of the same weight resting on the ground surface; however, at least part of this difference is because a hemisphere has a lower center of gravity than a sphere on the ground surface and thus has a lower height-of-burst.

Charge type and shape, however, have relatively small influence on crater dimensions compared to the dominance of the geology and depth-of-burst. Figure 2-5 shows that for a given explosive charge and test site, crater volume can vary by more than an order of magnitude, depending only on the depth-of-burst. Other parameters being equal, crater volumes can also vary by more than an order of magnitude depending on the particular type of soil

or rock and its moisture content. The geological influences are the major uncertainty in predicting crater dimensions for a particular field test. Great efforts have been devoted to analyzing cratering of various soils and rocks and the influence of height-of-burst and other explosive charge parameters. Of the numerous reports on the subject of cratering, the results from Reference 9 will be used. The author of Reference 9 is a noted authority on the subject, his report is concise but comprehensive, and his results are in a form that is most useful and understandable for the purposes of this study.

Interpretation of the data indicates that for surface bursts on a given "uniform" medium, the apparent crater volume is approximately proportional to the explosive yield. The apparent volume of a crater is the product of the yield and the "cratering efficiency," which is a function of the geologic medium, the explosive charge, and the height-of-burst. Also, evaluation of cratering data from different geologies suggests that height-of-burst effects can be separated from geological effects if height-of-burst dimensions are scaled inversely by the cube root of the apparent crater volume. Furthermore, for a given height-of-burst, cratering efficiency appears to be basically a function only of geology.

Figure 2-6 illustrates the best estimates of near-surface (within a few charge radii of the ground surface) cratering efficiency in various geologies. The tabular data (V_0) are crater volume per ton of explosive at a zero height-of-burst for various types of geologies. This figure illustrates the importance of the type of geology. Crater size increases as the geology is changed from hard rock to soft rock to dry soil to wet soil. A given charge size and depth-of-burst will produce a crater in wet clay that can be expected to be approximately 20 times the volume of a crater in hard rock. Figure 2-7 illustrates the data when all crater volumes are normalized by the cratering efficiency of the medium.

The summary of all this is that the apparent crater volume from a field test explosion within a few charge radii of the ground surface can be approximated by the following equation:

$$V_a = V_0 W \exp\left\{-5.2\, H(V_0 W)^{-1/3}\right\} \qquad (2\text{-}3)$$

where

V_a = expected apparent crater volume (ft^3)

V_0 = cratering efficiency of explosive for a zero height-of-burst (ft^3/ton)

W = TNT-equivalent explosive weight (tons)

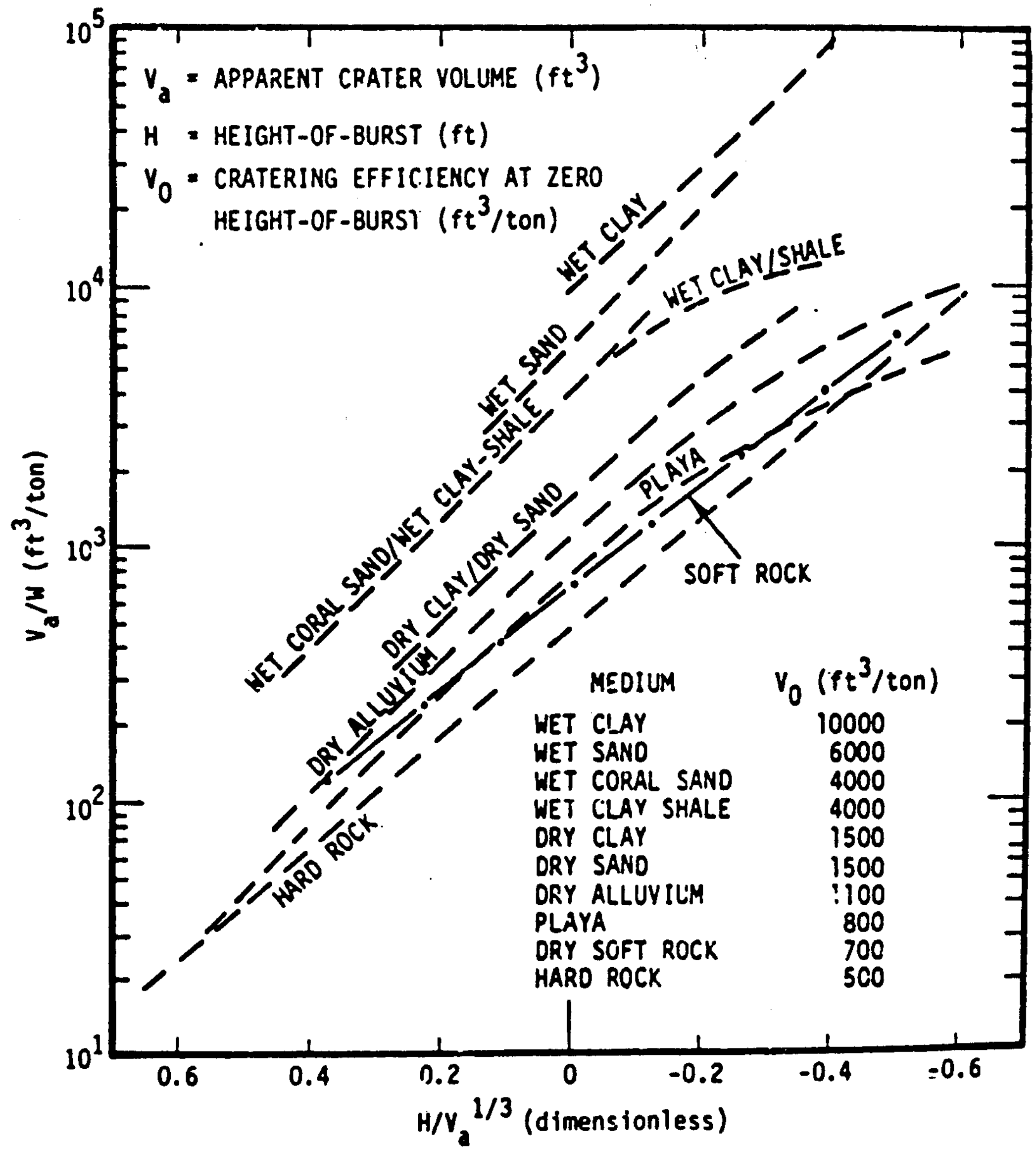


Figure 2-6. Near-surface HE cratering efficiencies. (Adapted from Reference 9)

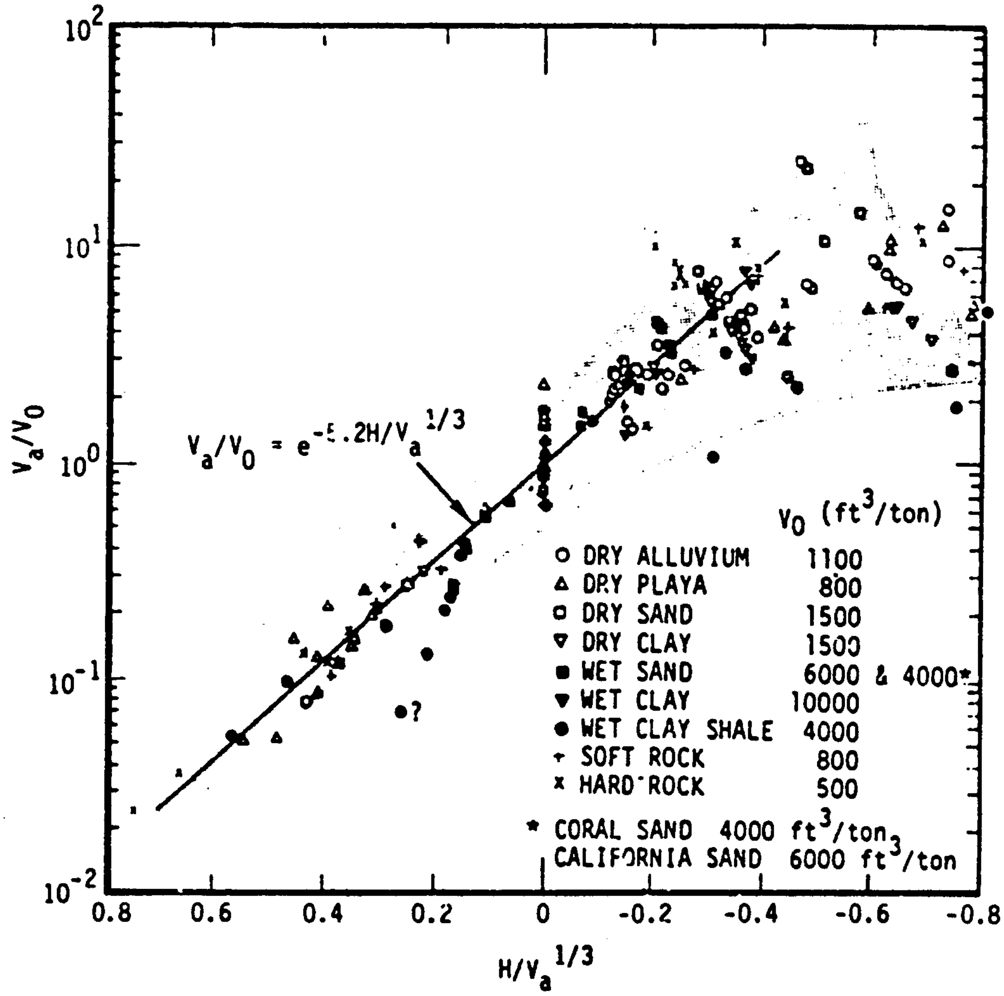


Figure 2-7. Normalized cratering efficiency for various geologies. (Adapted from Reference 9)

H = height-of-burst of the explosive charge (ft) (negative for buried charges).

(Since we are attempting to predict crater volumes rather than normalize known volumes into a data fit, the term V_0W is used in Equation 2-3 as the best estimate of the apparent crater volume.) Equation 2-3 is shown on Figure 2-7 where it can be seen that it is a reasonable fit to the data for near-surface heights-of-burst.

Cooper has gone further and has combined the various types of geologies into four basic categories of wet geologies (including soils and clay shales), dry soil, dry soft rocks, and dry hard rocks. The data organized into these categories are shown in Figures 2-8 through 2-11, from which he estimates the values of V_0 shown in Table 2-3. Using these values of V_0, Equation 2-3 has been plotted on the figures. Thus, to roughly predict a crater volume, either the values shown in Table 2-3 or the values tabulated in Figure 2-7 can be used for V_0 and either applied directly into Equation 2-3 or used in the appropriate figure (2-7 through 2-11). If the figures are used, a range of crater volumes that considers the data scatter can be estimated.

Figure 2-12 illustrates how crater depth and crater radius vary with crater volume. Thus, the following equations can be used to estimate crater depth and radius after the crater volume has been estimated as discussed previously:

$$R_a = 1.2\ V_a^{1/3} \tag{2-4}$$

$$D_a = 0.5\ V_a^{1/3} \tag{2-5}$$

where

R_a = apparent crater radius (ft)

D_a = apparent crater depth (ft)

V_a = apparent crater volume (ft^3).

For large HE craters (between 10^5 and 10^6 ft^3) in wet soil, however, the data points indicate shallower craters than predicted by Equation 2-5. This is consistent with results from large HE tests at a site with a shallow water table. Such sites tend to produce wider, but shallower, craters than those in dry geologies.

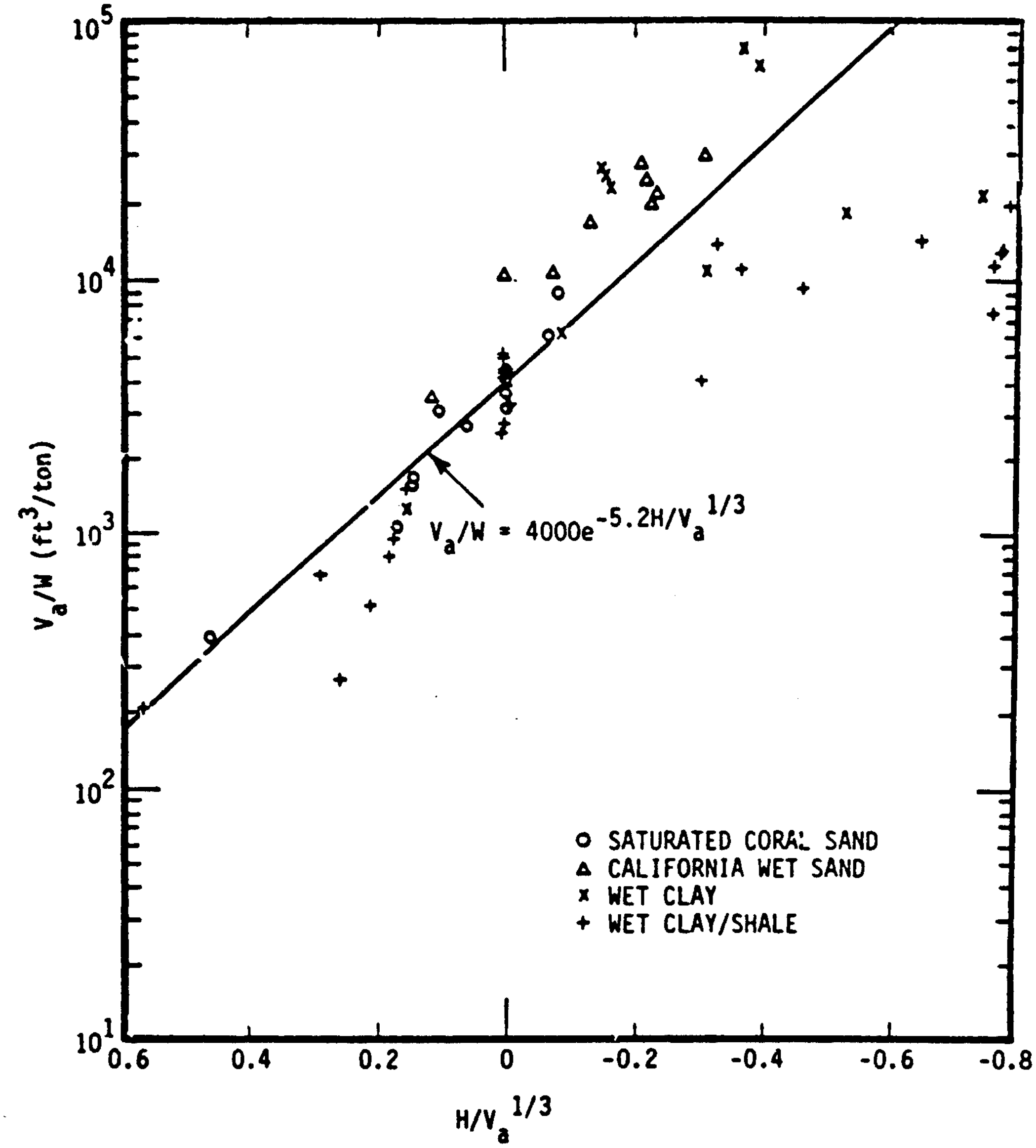


Figure 2-8. Near-surface HE cratering efficiency in wet geologies. (Adapted from Reference 9)

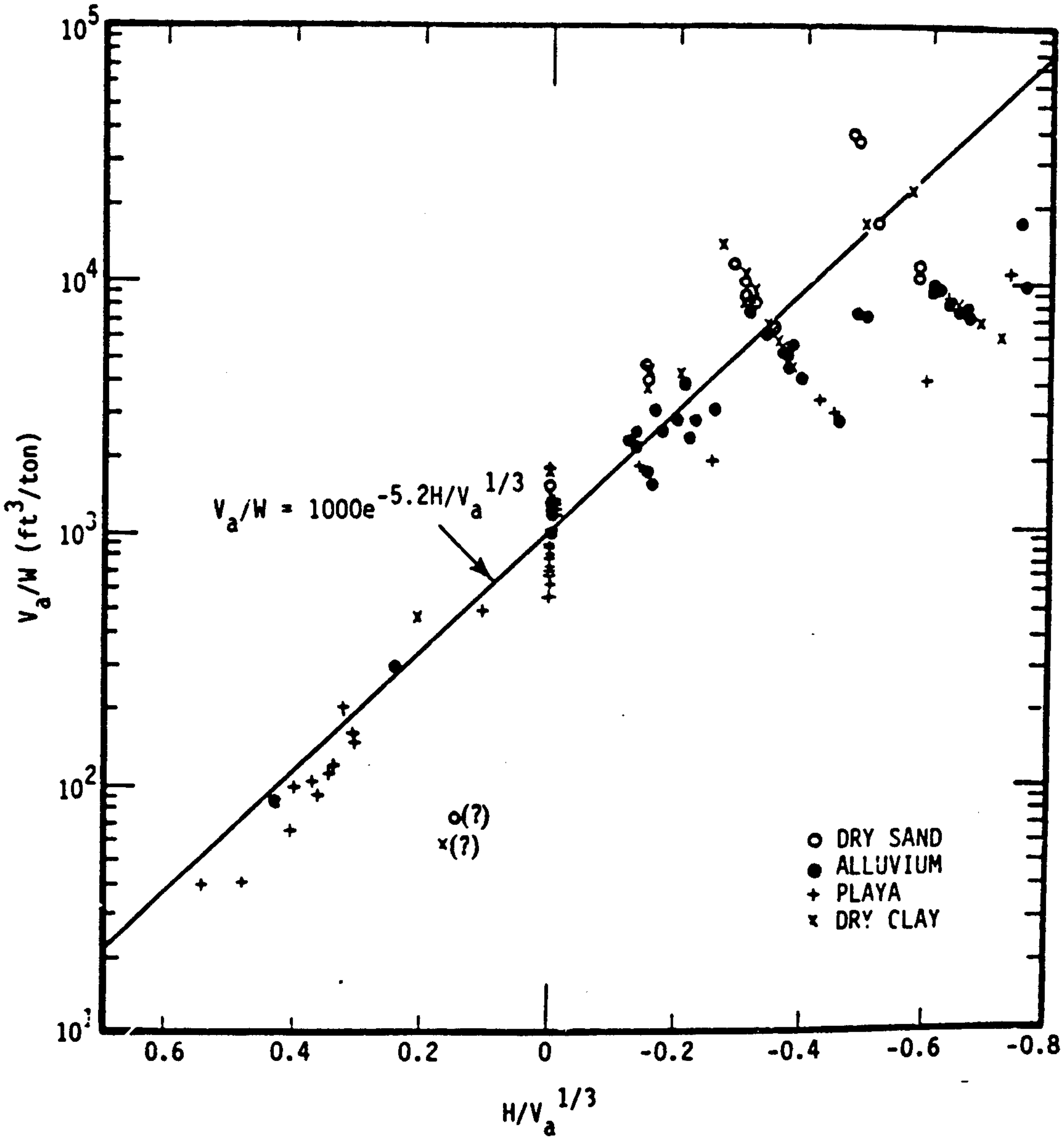


Figure 2-9. Near-surface HE cratering efficiency in dry soil. (Adapted from Reference 9)

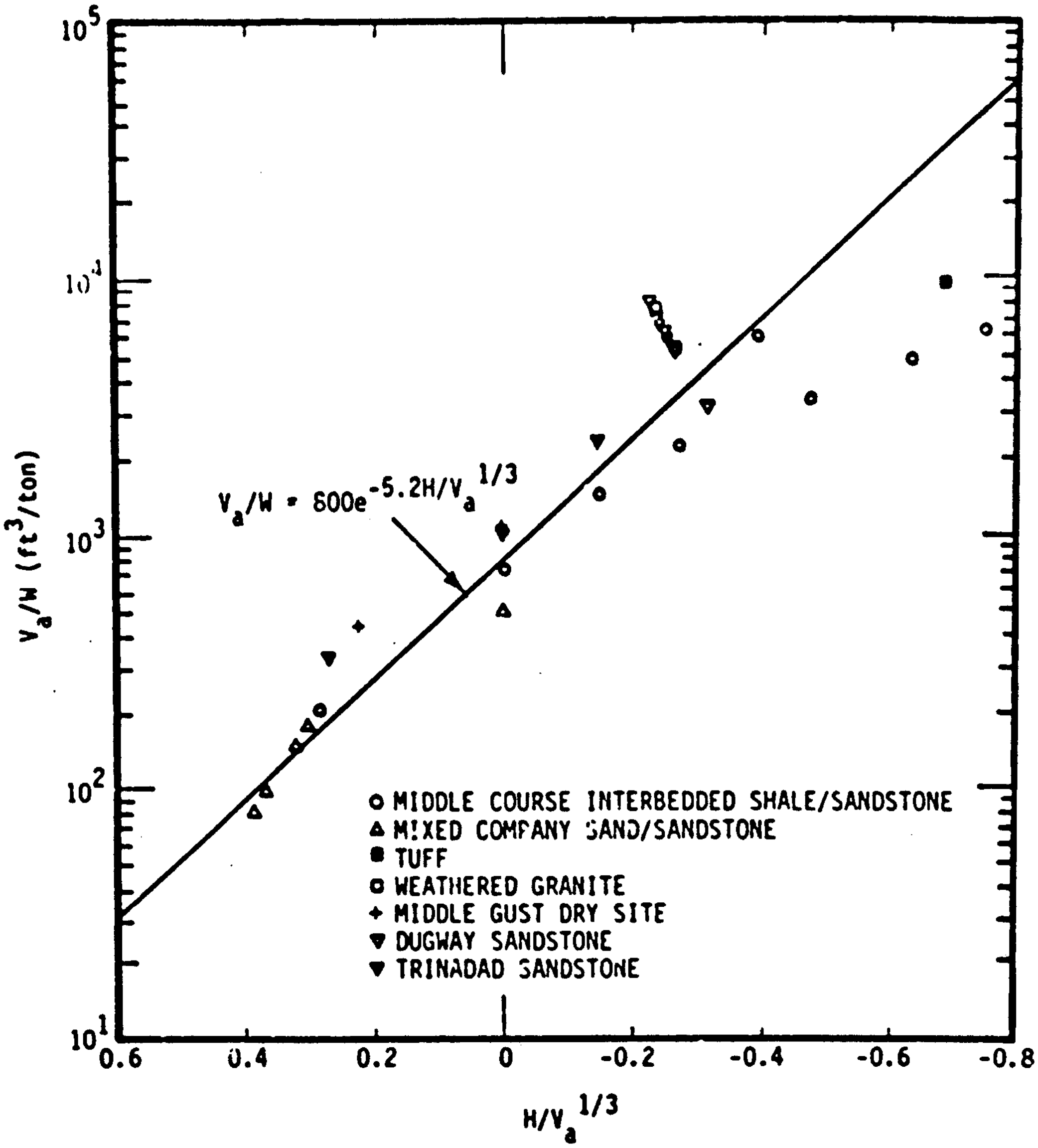


Figure 2-10. Near-surface HE cratering efficiency in dry soft rock. (Adapted from Reference 9)

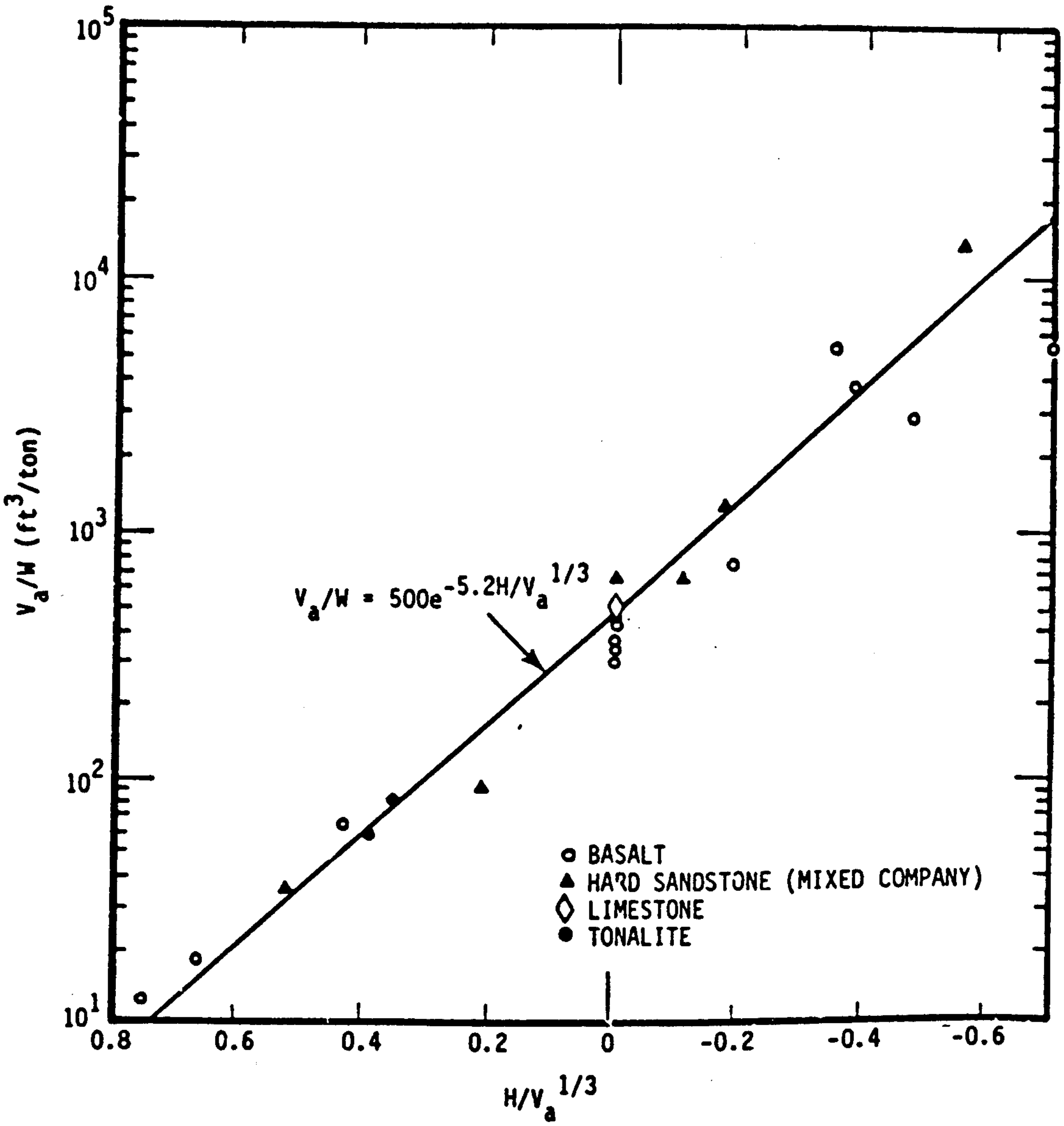


Figure 2-11. Near-surface HE cratering efficiency in dry hard rock. (Adapted from Reference 9)

Table 2-3. HE cratering efficiency for generic geologic materials. (Adapted from Reference 9)

Medium	V_0 (ft^3/ton) Range	Best Estimate
Wet Geology (including soils and clay shales)	2,000 to 8,000	4,000
Dry Soil	600 to 1,800	1,000
Dry Soft Rock	500 to 1,200	800
Dry Hard Rock	300 to 700	500

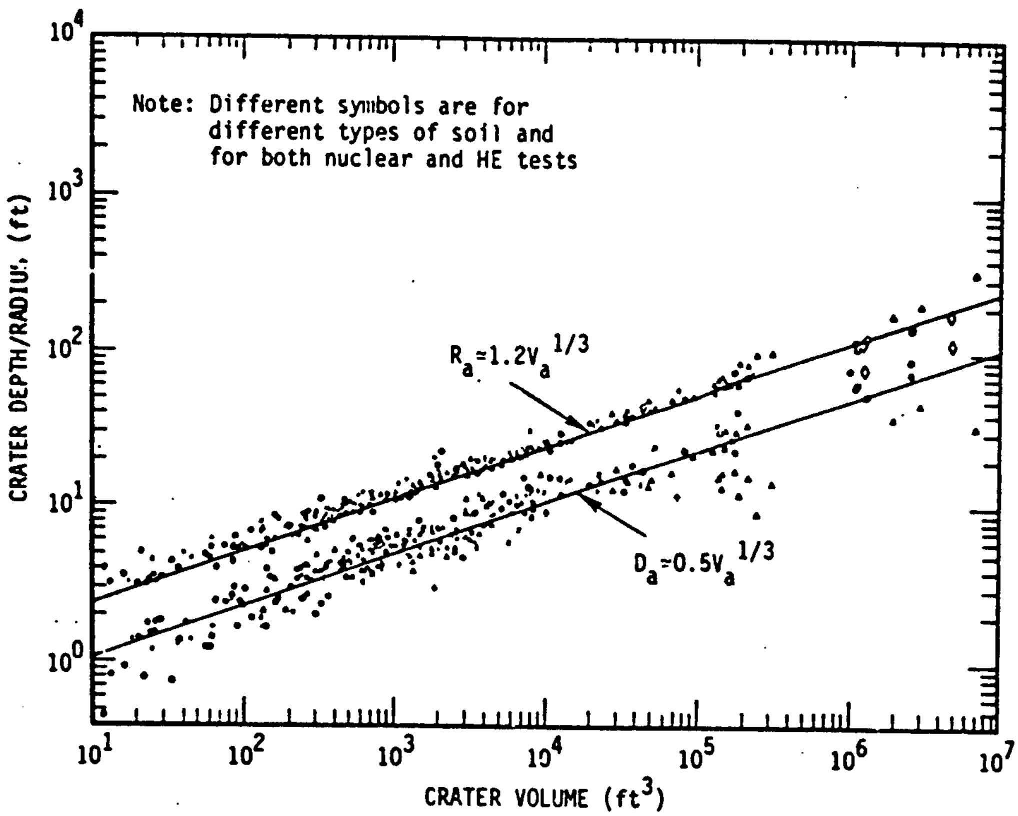


Figure 2-12. Crater radii and depths as functions of crater volume. (Adapted from Reference 9)

EJECTA AND MISSILES

Most of the ejecta, the earth materials from the apparent crater, from a large HE explosion are deposited within about 3 to 5 crater radii of ground zero (GZ), i.e., within a few hundred feet of a 500-ton charge. Beyond this distance, the ejecta do not completely cover the ground surface and the areal density decreases rapidly with increased distance from GZ.

The ground coverage of the ejecta can be estimated from Figure 2-13 as a function of crater dimensions and the density of earth materials. The unit weight of dry earth materials in-place varies, but reasonable values to use are 80 lb/ft^3 for porous earth, 90 lb/ft^3 for clay, 100 lb/ft^3 for sand, 120 lb/ft^3 for desert alluvium, 140 lb/ft^3 for soft rock, and 160 lb/ft^3 for hard rock.

Theoretically, some ejecta (missiles) can be propelled very long distances; in fact, however, very few missiles have been found beyond 3,000 feet from large HE explosions.

GROUND SHOCK

There are relatively few data on ground motion measurements from large HE field tests at distances of interest for environmental analysis, i.e., where the peak particle velocity is less than a few centimeters per second. Figure 2-14 shows the peak particle velocities from five HE field tests that had ground motion measurements at the magnitudes of interest. (All distances have been scaled to 1 ton of TNT by the cube root of the TNT-equivalent weight.) The three charges exploded either on the ground surface or, at most, just buried with the top of the charge flush with the ground surface (MIXED COMPANY III, JANGLE HE-2, AFWL 1-5) produced reasonably consistent ground motions, with the MIXED COMPANY III ground shock having the greatest magnitude. The more deeply buried charges in the ESSEX I--Phase 2 and PRE-GONDOLA--Shot B tests produced somewhat stronger ground shocks, as would be expected. In this study, the MIXED COMPANY III data will be assumed as the worst-case ground shock for near-surface explosions. Assuming that the maximum vertical, radial, and tangential peak particle velocities add vectorially,* the equation of the resultant peak ground motions can be expressed as follows:

$$V_{max} = 2{,}700\ (D/W^{1/3})^{-1.4} \qquad (2\text{-}6)$$

---

* The combined data are not given in the references, but adding the peak vectors results in the largest possible magnitudes of ground motion and therefore is a conservative assumption.

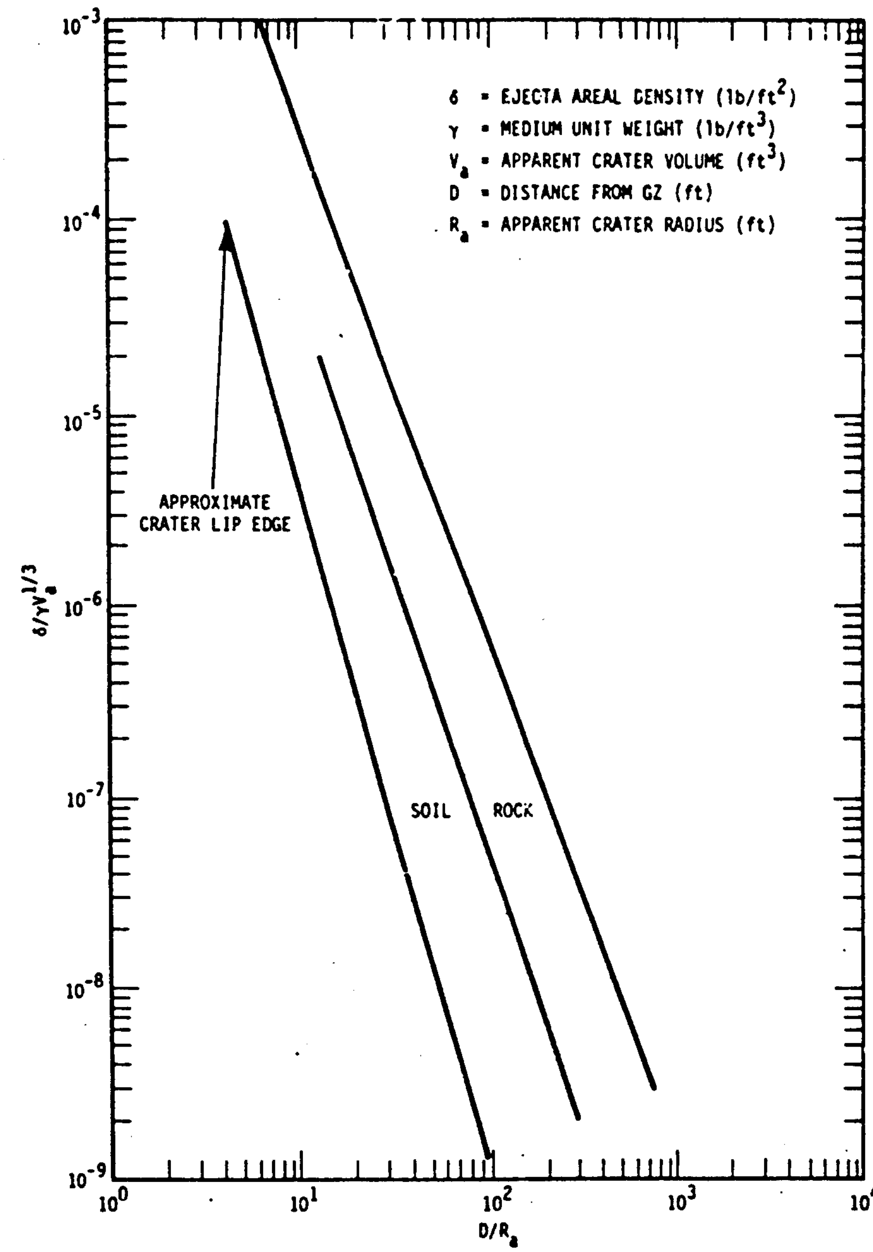


Figure 2-13. Dimensionless plot of ejecta mass density as a function of range (expressed as multi-'es of the apparent crater radius). (Source: Reference 10)

APPENDIX D-3

OPEN DETONATION FUGITIVE DUST EMISSION FACTORS (DECEMBER 1993)

RESOURCE CONSERVATION AND RECOVERY ACT SUBPART X PERMITTING SUPPORT

FOR THE

U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY

OPEN DETONATION FUGITIVE DUST EMISSION FACTORS

DECEMBER 1993

- FINAL -

TABLE OF CONTENTS

LIST OF TABLES

EXECUTIVE SUMMARY

This document presents an evaluation of available fugitive dust emission factor information applicable to open detonation (OD) sources. This evaluation has been conducted to support the Resource Conservation and Recovery Act (RCRA) Subpart X permitting needs of the U.S. Army for OD units which are of vital importance for the demilitarization of explosives.

The specific objective of this document is to provide guidance for the application of available OD fugitive dust emission factor information to meet the Subpart X permitting needs of the U.S. Army. A secondary objective is to determine if additional studies are warranted. These recommendations will provide the basis for the Subpart X permitting strategy to be incorporated into the Army-wide air pathway assessment guidance document (U.S. Army, 1993).

SUBPART X PERMITTING NEEDS

Cratering effects associated with OD operations result in the ejection of soil materials into the air. In addition, the OD blast wave effects result in the entrainment of surface soil particles into the air. Most of the larger soil particles (i.e., greater than 30 microns in diameter) fall back to the ground within three to five crater radii of the OD event. However, the smaller particles remain suspended and form a dust cloud. The U.S. Environmental Protection Agency (EPA) and states have promulgated stringent ambient air quality standards for total suspended particulates (TSP) applicable to particles which are generally less than 20-50 microns in diameter and more recently for PM10 (i.e., particles 10 microns or less in diameter).

The U.S. EPA has yet to issue regulatory guidance specifically applicable to OD units and RCRA Subpart X permit applications. Potential air quality impacts associated with the OD dust cloud based on available screening methods may be a permitting issue at many Army installations with OD units. Therefore, an evaluation of available OD dust cloud studies and a determination of appropriate fugitive dust emission factors are warranted to support the Subpart X permitting needs of the Army.

DETERMINATION OF OD FUGITIVE DUST EMISSION FACTORS

Alternative approaches for the determination of OD fugitive dust emission factors are discussed in this section. This evaluation includes the following:

- Current Subpart X permitting approach
- Application of Army OD field test data (1989-1990) from Dugway Proving Ground (DPG)
- Comparison of alternative approaches

Available data to characterize OD dust clouds and associated fugitive dust emission factors are very limited. The current approach used for Subpart X permitting for many installations has been based on the expected OD crater volumes (using a standard crater algorithm) and installation-specific soil conditions (to account for the fraction of PM10--i.e., equal to or less than 10 microns in diameter--particles in the soil). This approach for the source OD scenario resulted in an emission factor three times greater than the estimate based on the Army OD field tests (1989-1990) at DPG. Moreover, for a 2,000 lb detonation, the approach based on DPG data indicates compliance with the National Ambient Air Quality Standards (NAAQS) for PM10 at a downwind distance of 1 kilometer or more. However, the alternate approach would result in an exceedance of the 24-hour PM10 standard.

CONCLUSIONS AND RECOMMENDATIONS

The emission factor methodology based on the U.S. Army surface OD field tests (1989-1990) at DPG is recommended to be used for Subpart X permitting on an Army-wide basis. This methodology was selected since it has been based on actual field tests which measured suspended particulate concentrations in OD clouds as well as crater dimensions. Installation-specific soil and OD conditions are used to scale the emissions factors based on the DPG tests. The maximum DPG emission factor (1.0E1) from these tests should be used as input to evaluate installation-specific short-term (24-hour or less) exposure scenarios and the test-wide DPG average (5.7E0) for long-term exposure periods (greater than 24 hours).

The short-term emission factor generally presents the greatest difficulty relevant to compliance with PM10 ambient air standards for OD sources. Based on dispersion estimates presented in the Army-wide screening guidance document (U.S. Army, 1993) for a 2,000-pound detonation, the maximum ground-based concentration would be in compliance with the 24-hour NAAQS for PM10 at a downwind distance of 500 meters or more (assuming flat terrain). Also, based on the DPG approach, greater than 1,000 tons NEW could be treated by OD and still be in compliance with annual PM10 standards at downwind distances of 1 kilometer or more (flat terrain). Thus, the recommended approach should be acceptable for most permitting applications. For certain installations, however, a more refined evaluation (e.g., accounting for PM10 content of the soil based on soil tests) may be warranted. Also, inclusion of quantitative OD dust cloud assessments in Subpart X permit applications may not be appropriate when predicted exceedances of the PM10 standard are not supported by visual observations of the OD dust cloud and associated crater dimensions. For these cases a qualitative statement of OD dust cloud impacts should be based on installation-specific observations.

The recommended approach, however, is limited to surface detonations. Even the alternative (DNA) approach is limited to near-surface detonations. Therefore, it is recommended that additional OD tests be conducted at DPG to evaluate fugitive dust emission factors for subsurface detonations. This is necessary because many installations conduct subsurface detonations. Bangbox tests in lieu of field tests might be a cost-effective approach to consider. However, major modifications to the design of the DPG bangbox would be needed to accomplish this mission. Another approach to consider involves obtaining limited field data (e.g., crater dimension, OD cloud heights) from a representative number of OD installations.

1.0 INTRODUCTION

This document presents an evaluation of available fugitive dust emission factor information applicable to open detonation (OD) sources. This evaluation has been conducted to support the Resource Conservation and Recovery Act (RCRA) Subpart X permitting needs of the U.S. Army for OD units which are of vital importance for the demilitarization of explosives.

The regulatory requirements established under RCRA for miscellaneous units, including open burning/open detonation (OB/OD) units, are set forth in 40 CFR Part 264, Subpart X. Subpart X requires that a miscellaneous unit "be located, designed, constructed, operated, maintained and closed in a manner that will ensure protection of human health and the environment." These requirements differ from those developed for other RCRA units (e.g., landfills, incinerators) in that they establish a standard based on meeting a certain level of environmental performance—an environmental performance standard—rather than meeting pre-established design and operating standards. For example, Subpart X does not specify minimum technology requirements (e.g., liners, leak detection systems) or monitoring requirements, as it does for land-based RCRA units, such as landfills. Rather, these requirements must be established on a unit-specific basis to protect human health and the environment. A health and environmental assessment, therefore, is needed for each Subpart X unit to establish installation-specific environmental performance standards. These environmental performance standards and the associated health and environmental assessment must be included in the Part B permit application for Subpart X units. The air pathway analysis is a critical component of the health and environmental assessment and is a determinant of the installation-specific environmental performance standard for OB/OD units.

The conduct of air pathway assessments for OB/OD units consists of the following steps:

- Obtain OB/OD unit and waste characterization data
- Calculate air emission factors
- Identify relevant air criteria
- Conduct dispersion modeling
- Evaluate air pathway impacts

The availability of air emission factors is critical for the air pathway assessment process. However, only limited OD fugitive dust emissions data are available to support RCRA Subpart X permit applications.

1.1 OBJECTIVES

The U.S. Army Environmental Center (AEC) has been designated to coordinate the U.S. Army Subpart X permitting effort. This support includes addressing those aspects that have Army-wide impact and working with other Department of Defense (DOD) organizations (such as the Ordnance Executive Steering Committee) and regulatory agencies to assist Installation Commanders in obtaining permits for OB/OD operations. A major component of its support is the development of technical guidance for the conduct of air pathway assessments applicable to OB and OD units to support Subpart X permit applications.

The specific objective of this document is to provide guidance for the application of available OD fugitive dust emission factor information to meet the Subpart X permitting needs of the U.S. Army. A secondary objective is to determine if additional studies are warranted. These recommendations will provide the basis for the Subpart X permitting strategy to be incorporated into the Army-wide air pathway assessment guidance document (U.S. Army, 1993).

1.2 REPORT ORGANIZATION

Background information on Subpart X permitting needs of the U.S. Army and a synopsis of available OD dust cloud studies are presented in Section 2.0. Approaches for the determination of OD fugitive dust emission factors are discussed in Section 3.0. Conclusions and recommendations are provided in Section 4.0, and a list of references is included in Section 5.0.

2.0 BACKGROUND INFORMATION

In order to achieve the objectives of this document, it is necessary to consider the Subpart X permitting needs of the U.S. Army and to determine the availability of OD fugitive dust emission factors. This background information is included in Sections 2.1 and 2.2, respectively.

2.1 SUBPART X PERMITTING NEEDS

Cratering effects associated with OD operations result in the ejection of soil materials into the air. In addition, the OD blast wave effects result in the entrainment of surface soil particles into the air. Most of the larger soil particles (i.e., greater than 30 microns in diameter) fall back to the ground within three to five crater radii of the OD event. However, the smaller particles remain suspended and form a dust cloud. The U.S. Environmental Protection Agency (EPA) and states have promulgated stringent ambient air quality standards for total suspended particulates (TSP) applicable to particles which are generally less than 20-50 microns in diameter and more recently for PM10 (i.e., particles 10 microns or less in diameter).

The U.S. EPA has yet to issue regulatory guidance specifically applicable to OD units and RCRA Subpart X permit applications. Potential air quality impacts associated with the OD dust cloud based on available screening methods may be a permitting issue at many Army installations with OD units. Therefore, an evaluation of available OD dust cloud studies and a determination of appropriate fugitive dust emission factors are warranted to support the Subpart X permitting needs of the Army.

2.2 OD DUST CLOUD STUDIES

A literature search was conducted to identify available OD dust cloud studies. In addition, the AEC, Dugway Proving Ground (DPG), and the Army Environmental Hygiene Agency (AEHA) were contacted. Based on this search the following reports were identified and reviewed:

- High-Explosive Field Tests - Explosion Phenomena and Environmental Impacts, Defense Nuclear Agency (DNA), October 1981 (crater volume data)
- Estimates of Crater Dimensions for Near-Surface Explosions of Nuclear and High-Explosive Sources, Lawrence Livermore Laboratory (LLL), September 1976 (crater volume and limited cloud particulate mass data)
- Electro-Optical Systems Atmospheric Effects Library (EOSAEL), U.S. Army, January 1981 (crater volume data)
- ASL-DUST: A Tactical Battlefield Dust Cloud and Propagation Code, U.S. Army, June 1980 (crater volume data)
- Combined Obscuration Model for Battlefield-Induced Contaminants, COMBIC, U.S. Army, October 1987 (crater volume and cloud concentration data)
- Final Report: Development of Methodology and Technology for Identifying and Quantifying Emission Products from Open Burning and Open Detonation Thermal Treatment Methods, U.S. Army, January 1992 (crater volume and cloud concentration data)

In general, there are only limited data available regarding OD dust clouds and associated fugitive dust emission factors applicable to detonation sources. Most of the available data are based on or summarized in the DNA report referenced above. The DNA document includes an algorithm for the estimation of OD crater volumes as well as dust cloud height and size. Installation-specific soil particle-size distribution data can be used with crater volume data to estimate OD fugitive dust emission factors. This approach is explained in further detail in Section 3.1 of this document.

The results from recent OD field tests conducted by the U.S. Army are presented in the January 1992 report cited above. These OD field tests were conducted in 1989 and 1990 at DPG. Information obtained during these studies that is applicable to characterization of the OD dust cloud include the following for surface detonations:

- Suspended particulate concentrations from aircraft sampling of OD dust clouds
- Measurements of OD crater dimensions and estimated volumes
- DPG soil tests, including limited particle-size distribution data
- Suspended particulate emission factors due to incomplete combustion products from small-scale detonations conducted in a bangbox

Subsurface detonation tests were not conducted during the Army OD field study at DPG. Also, the final report for the study does not include OD fugitive dust cloud emission factors. However, these recent OD field tests warrant further evaluations and, together with the DNA report, represent the best available data for characterizing OD dust clouds. The application of data from the Army OD field tests (1989-1990) to determine fugitive dust emission factors is discussed in Section 3.2 of this document.

3.0 DETERMINATION OF OD FUGITIVE DUST EMISSION FACTORS

Alternative approaches for the determination of OD fugitive dust emission factors are discussed in this section. This evaluation includes the following:

- Current Subpart X permitting approach
- Application of Army OD field test data
- Comparison of alternative approaches

The recommended approach for the determination of OD particulate emission factors is presented in Section 4.0.

3.1 CURRENT SUBPART X PERMITTING APPROACH

An approach based on OD expected crater volumes and installation-specific soil particle size distributions has been used to estimate OD fugitive dust emissions for Subpart X permitting.

A methodology based on crater volume estimates from high-explosion field tests evaluated by the DNA (October 1981) has been used to estimate the fugitive dust emission factors for OD operations. This methodology can be summarized as follows:

$$EF_{dc\text{-}PM10} = \frac{V_{ac} \ x \ D_s \ x \ F_{PM10}}{W_{lb}} \qquad \text{Eq. 3.1-1}$$

where

$EF_{dc\text{-}PM10}$ = OD dust cloud emission factor for PM10 (respirable particulate of 10 microns or less) matter (lb of particulate per lb of material detonated)

V_{ac} = expected apparent crater volume (ft^3)

D_s = density of the soil (lb/ft^3)

F_{PM10} = fraction of crater volume which consists of particles less than or equal to 10 microns (dimensionless)

W_{lb} = net explosive weight of the energetic material to be treated by OD (lb)

The expected apparent crater volume has been based on the following equations (DNA, October 1981):

$$V_{ac} = V_{ce} \ x \ W_{gc} \ \exp \ [-5.2H_b \ (V_{ce} \quad W_{gc})^{-0.33}] \qquad \text{Eq. 3.1-2}$$

where

V_{ce} = cratering efficiency for a zero height of burst based on Table 3.1-1 (ft^3/ton)

H_b = height of the burst in feet; negative if below ground with soil cover (not applicable to more than a few charge radii below the surface)

W_{gc} = TNT-equivalent net explosive weight relative to ground cratering (tons)

Table 3.1-1. Summary of Cratering Efficiency Values, V_{ce} (DNA, October 1981)

Medium	V_{ce} (ft^3/ton)	
	Range	Best Estimate
Wet geology (including soils and clay shales)	2,000 to 8,000	4,000
Dry soil	600 to 1,800	1,000
Dry soft rock	500 to 1,200	800
Dry hard rock	300 to 700	500

and

$$W_{gc} = TF \times W \qquad \text{Eq. 3.1-3}$$

where

TF = TNT-equivalent weight factor relative to ground cratering efficiency which is related to total energy content and not to detonation velocity

W = net explosive weight detonation charge (tons)

Soil density is determined based on the applicable soil-texture classification considering installation-specific soil conditions. Estimates of the PM10 (respirable particles) content of the soil are also based on soil-texture classification or soil particle size data from installation-specific soil samples.

The TNT-equivalent weight factor, TF, relative to ground cratering efficiency generally ranges from 0.68 (for dynamite) to 1.64 (for C-4 explosives).

Emission factors based on Eq. 3.1-1 for surface detonations do not vary as a function of crater volume for similar soil conditions and TNT-equivalent net explosive weight of detonation charge.

The above-referenced approach provides an extremely conservative PM10 emission factor. This poor performance is attributed to a weaker correlation of the airborne distribution of small particles to the parent soil than might be expected based on various field tests. These differences may be due to soil analysis techniques that break up soil agglomerates, to the agglomeration of particles by explosive shock, and to other factors (U.S. Army, October 1987).

In addition, the approach is unrealistically conservative for subsurface detonations. This poor performance is attributed to limitations of the applicability of Eq. 3.1-2 (crater volume) to subsurface depths within a few charge radii from the soil surface. At greater depths, the predicted crater volumes become increasingly unrealistic.

3.2 APPLICATION OF ARMY OD FIELD TESTS DATA (1989-1990)

Measurements of suspended particulate within OD clouds available from Army field tests conducted in 1989-1990 (as discussed in Section 2.2) involving surface detonations provide an alternative method to the approach discussed in Section 3.1 for the estimation of emission factors. These cloud particulate concentration data, in conjunction with an estimate of the OD cloud volume, can be used to estimate the total mass of suspended particulates which have been emitted. The ratio of the mass of suspended particulates to the weight of the energetic material detonated provides an estimate of a suspended particulate emission factor applicable to OD dust clouds (i.e., accounting for particulates from incomplete combustion as well as entrained soil particles).

The following equations can be used to calculate the initial cloud volume term (DNA, October 1981):

$$V_c = (3E7)\ (W')^{0.75} \qquad \text{Eq. 3.2-1}$$

where

V_c = initial cloud volume (m^3)
W' = TNT-equivalent net explosive weight (<u>tons</u>)

and

$$W' = (TF)\ (W) \qquad \text{Eq. 3.2- 2}$$

where

TF = TNT-equivalent weight factor (dimensionless)
W = net explosive weight of energetic material item for OD treatment (<u>tons</u>)

The total mass of suspended particulates can be estimated as follows:

$$M_{tsp} = (V_c)\ (C_{tsp})\ (1.1E{-}9) \qquad \text{Eq. 3.2-3}$$

where

M_{tsp} = mass of total suspended particulates (tons)
V_c = initial cloud volume (m^3)
C_{tsp} = average concentration of total suspended particulates in the cloud (mg/m^3)

Total suspended particulate emission factors can then be estimated by means of the following equation:

$$EF_{tsp} = \frac{M_{tsp}}{W'} \qquad \text{Eq. 3.2-4}$$

where

EF_{tsp} = total suspended particulate emission factors for the OD dust cloud (dimensionless)

A summary of the values for parameters used to calculate the total suspended particulate emission factors for OD is presented in Table 3.2-1. The OD cloud total suspended particulate concentration data from the DPG surface detonation tests are presented in Appendix A. Emission factors based on the DPG surface detonation field tests are presented in Table 3.2-2. These TNT field test emission factors are higher by a factor of approximately 1,000 compared to the bangbox tests for TNT (since the bangbox results account only for products of incomplete combustion and not fugitive dust emissions).

Since PM10 measurements of cloud particulate concentrations are not available from the Army OD field tests (1989-1990) conducted at DPG, the following conservative assumption can be made for Subpart X permitting:

$$EF_{dpg-PM10} = EF_{PM10} = EF_{tsp} \qquad \text{Eq. 3.2-5}$$

where

$EF_{dpg\text{-}PM10}$ = PM10 (particles 10 microns or less in diameter) emission factor for the OD dust cloud applicable to DPG (dimensionless)

EF_{PM10} = PM10 emission factor for the OD dust cloud (dimensionless)

The DPG-specific emission factor can be applied to other installations, assuming that PM10 emissions are directly related to the apparent crater volume as follows:

$$\frac{EF_x}{V_x} = \frac{EF_{dpg}}{V_{dpg}} \qquad \text{Eq. 3.2-6}$$

where

EF_x = PM10 emission factor for the OD dust cloud at installation "X" (dimensionless)

Table 3.2-1. Summary of Data from the Army Field Tests (1989-1990) Used To Calculate Emission Factors for Total Suspended Particulates Applicable to OD Dust Clouds

Factor	TNT Surface Detonations			Phase C Surface Detonations		
	Phase A	Phase B	Phase C	Comp B	Exp D	RDX
W Net explosive weight (tons)	1.0	1.0	1.0	1.0	1.0	1.0
TF TNT-equivalent weight factor (dimensionless)	1.0	1.0	1.0	INA*	INA*	INA*
V_c Initial OD cloud volume (m^3)	3.0E7	3.0E7	3.0E7	3.0E7	3.0E7	3.0E7
C_{tsp} Average concentration of OD cloud (mg/m^3)						
+ Average of all test events	45	62	258	205**	250**	211**
+ Maximum test event average	65	85	268	218	315	242
M_{tsp} Mass of suspended particulates of OD cloud (tons)						
+ Average of all test events	1.5	2.0	8.5	6.8	8.3	7.0
+ Maximum test event average	2.1	2.8	8.8	7.2	10.4	8.0

INA = Information not applicable
*TF assumed to be 1.0.
**Based on average of maximum and minimum values.

Table 3.2-2. Summary of Emission Factors (Suspended Particulate Emission Mass per Energetic Mass Detonated) for Total Suspended Particulates Applicable to OD Dust Clouds Based on Army Emission Tests (1989-1990)

EF_{tsp} Total suspended particulate emission factor	TNT Bangbox*	Field Tests						Field Test Summary	
		TNT Surface Detonations			Phase C Surface Detonations				
		Phase A	Phase B	Phase C	Comp B	Exp D	RDX	Max	Avg
Average of all test events	6.7E-3	1.5	2.0	8.5	6.8	8.3	7.0	8.5	5.7**
Maximum test event average	9.6E-3	2.1	2.8	8.8	7.2	10.4	8.0	10.4***	8.5

* Based on elemental carbon emission factor. Does not account for entrained soil.

** Applicable to long-term exposure periods of greater than 24 hours.

*** Applicable to short-term exposure periods of 24 hours or less.

V_x = apparent crater volume applicable to installation "X" based on Eq. 3.1-2 (ft^3)

V_{dpg} = apparent crater volume (see Appendix B) applicable to the OD field tests (1989-1990) at DPG for surface detonations and a best estimate of cratering efficiency of 1,000 ft^3/ton for dry soil based on Eq. 3.1-2 (see Appendix C for DPG soil data) (1,000 ft^3)

Eq. 3.2-6 is also equivalent to the following:

$$EF_x = \left(\frac{V_x}{V_{dpg}}\right) EF_{dpg} \qquad \text{Eq. 3.2-7}$$

and, since V_{dpg} = 1,000 ft^3

$$EF_x = \left(\frac{V_x}{1{,}000}\right) EF_{dpg} \qquad \text{Eq. 3.2-8}$$

The validity of this relationship is based on the assumption that the DNA approach presented in Eq. 3.1-2 will provide a reasonable estimate of the crater volume for surface and shallow detonations. This assumption was tested by comparing crater volume estimates based on crater depth and radius measurements from the DPG surface detonation tests to a value calculated using the DNA approach. The results of this comparison verify the performance of Eq. 3.1-2. The DPG field measurements result in an average crater volume of 1,012 ft^3 for the OD tests versus 1,000 ft^3 based on the DNA algorithms. Therefore, Eq. 3.2-8 provides a convenient basis to estimate installation-specific PM10 emission factors applicable to OD dust clouds for Subpart X permitting.

3.3 COMPARISON OF ALTERNATIVE OD FUGITIVE DUST EMISSION FACTORS APPROACH

An estimate of the emission factor for TSP (less than 30 microns) based on the approach presented in Section 3.1 has been compared to results based on the Section 3.2 methodology. For both cases the same OD source scenarios based on the Army field tests (1989-1990) conducted at DPG were used. A summary of the source scenarios and associated emission factor results is presented in Table 3.3-1.

The scenarios presented in Table 3.3-1 represent average source and soil conditions for the Army OD field tests (1989-1990) at DPG. A soil density of 2.5 g/cc (equivalent to 156 lb/ft^3) was reported in the summary reports for the Army OD field tests (U.S. Army, January 1992). The average F_{TSP} value was based on an evaluation of DPG soil test measurements presented in Appendix B. Soil test results were presented in terms of percentage of fines (i.e., less than 200 mesh, which is equivalent to particles with diameters less than 80 microns). The TSP measured during the DPG field tests represent diameters of approximately 30 microns or less. Therefore, to estimate F_{TSP} the fraction of the soil which are fines (0.61) at DPG was scaled by a factor (30 microns/80 microns) to account for the fraction of particles 30 microns or less (assuming a linear size distribution). A similar approach was used for estimating F_{PM10} and associated $EF_{dc\text{-}PM10}$ values.

Emission factors were calculated using Eq. 3.1-1 for the Section 3.1 approach and Eq. 3.2-8 plus Table 3.2-2 for the Section 3.2 approach. The emission factor based on Section 3.1 is approximately a factor of two greater than the Section 3.2 value and a factor of three greater for the long-term value.

Table 3.3-1. Summary of Example OD Source Scenarios and Associated Emission Factor Results

Parameter	Section 3.1 Approach	Section 3.2 Approach
V_{sp} Crater volume (ft^3)	1.0E3	1.0E3
D_s Soil density (lb/ft^3)	1.6E2*	Not applicable
F_{tsp} Fraction of soil 30 microns or less (dimensionless)	2.3E-1	Not applicable
W Net explosive weight of OD item (lb)	2.0E3	2.0E3 (1.0 ton)
$EF_{dc\text{-}tsp} = EF_{dc\text{-}PM10}$ Short-Term ($\leq$ 24 hours)	1.8E1	1.0E0
$EF_{dc\text{-}tsp} = EF_{dc\text{-}PM10}$ Long-Term (> 24 hours)	1.8E1	5.7E0

*Based on reported DPG soil density of 2.5 g/cc (U.S. Army, January 1992)

4.0 CONCLUSIONS AND RECOMMENDATIONS

Available data to characterize OD dust clouds and associated fugitive dust emission factors are very limited. An approach used for Subpart X permitting for many installations has been based on the expected OD crater volumes (using the DNA algorithm) and installation-specific soil conditions (to account for the fraction of PM10 particles in the soil). This approach for the source OD scenario resulted in an emission factor three times greater than the estimate based on the Army OD field tests (1989-1990) at DPG. Moreover, for a 2,000 lb detonation, the approach based on DPG data indicates compliance with the National Ambient Air Quality Standards (NAAQS) for PM10 at all downwind distances. However, the DNA approach would result in an exceedance of the 24-hour PM10 standard at a distance of 500 meters.

The emission factor methodology based on the OD field tests (1989-1990) at DPG should be considered for use for Subpart X permitting on an Army-wide basis. This methodology, as discussed in Section 3.2, was selected since it has been based on actual field tests which measured TSP concentrations in OD clouds as well as crater dimensions. Therefore, Eqs. 3.2-6 through 3.2-8, based on the DPG field tests, should be used and the PM10 emission factors should be conservatively set equal to the TSP emission factors. The maximum emission factor (1.0E1) from Table 3.2-2 should be used as input to Eqs. 3.2-6 through 3.2-8 to evaluate short-term (24-hour or less) exposure scenarios and the test-wide average (5.7E0) as input for long-term exposure periods (greater than 24 hours). These recommendations are summarized in Table 4.0-1. Less conservative emission factors could be postulated if PM10 cloud measurements were available from the DPG tests.

The short-term emission factor generally presents the greatest difficulty relevant to compliance with PM10 ambient air standards for OD sources. Based on dispersion estimates presented in the Army-wide screening guidance document (U.S. Army, 1993) for a 2,000-pound detonation, the maximum ground-based concentration occurs at a downwind distance of 500 meters for an example scenario. At this distance, compliance with the 24-hour NAAQS for PM10 is indicated for the DPG emission factor approach but not for the DNA approach, as indicated in Table 4.0-2. However, compliance with the 24-hour PM10 standard occurs at all other distances for both approaches. Example allowable OD treatment amounts are presented in Table 4.0-3. Based on the DPG approach, greater than 1,000 tons NEW could be treated by OD and still be in compliance with annual PM10 standards for this example scenario. Thus, the approach based on DPG data should be acceptable for many permitting applications. For certain installations, however, a more refined evaluation (e.g., accounting for PM10 content of the soil based on soil tests) may be warranted.

Inclusion of quantitative OD dust cloud assessments in Subpart X permit applications may not be appropriate when predicted exceedances of the PM10 standard are not supported by visual observations of the OD dust cloud and associate craters. For example, quantification predictions may indicate a significant net loss of soil from the OD area which is not observed after repeated detonations or unrealistic crater dimensions. For these cases,

Table 4.0-1. Summary of Recommended Input to Equations 3.2-6 through 8

Basis	$EF_{dpg\text{-}PM10}$ * (PM10 emission factors)	Applicable Exposure Period
DPG tests (Section 3.2 methodology)	1.0E1	Short-term (24 hours or less)
DPG tests (Section 3.2 methodology)	5.7E0	Long-term (greater than 24 hours)

* DPG emission factors (pounds of PM10 emitted per pound of energetics treated) to be used on an Army-wide basis as input to Eqs. 3.2-6 through 8 to determine installation-specific emission factors.

Table 4.0-2. Example OD Fugitive Dust Cloud Maximum Short-Term Impacts (2,000 lb NEW Detonation)*

Emission Factor Approach	EF_{PM10} (dimensionless)**	Maximum 24-Hour Concentration ($\mu g/m^3$)	24-Hour NAAQS PM10 ($\mu g/m^3$)
DNA (Section 3.1)	1.8E1	177	150
DPG (Section 3.2)	1.0E1	99	150

* Maximum occurs at 500 m (assuming flat terrain and a surface detonation). Compliance with the 24-hour NAAQS PM10 occurs at all other distances for both the DNA and DPG emission factor approaches.

** Pounds of PM10 emissions per pound of energetics treated.

Table 4.0-3. Example Allowable Annual OD Treatment Amounts

Emission Factor Approach	Annual Allowable OD Treatment Amount (NEW tons)*
DNA (Section 3.1)	4.1E2
DPG (Section 3.2)	1.3E3

* Based on compliance with NAAQS PM10 annual standard (50 $\mu g/m^3$) at downwind distances of $\geq$ 1 km (assuming flat terrain and a surface detonation).

which frequently involve subsurface detonations, a qualitative statement of OD dust cloud impacts should be based on installation-specific observations.

The DPG emissions factor approach is limited to surface detonations. Even the alternative (DNA) approach is limited to near-surface detonations. Therefore, it is recommended that additional OD tests be conducted to evaluate fugitive dust emission factors for subsurface detonations. This is necessary since many installations conduct subsurface detonations. Bangbox tests in lieu of field tests might be a cost-effective approach to consider. However, major modifications to the design of the DPG bangbox would be needed to accomplish this mission. Another approach to consider involves obtaining limited field data from a representative number of active OD installations. Key data parameters for such studies would include crater dimensions, soil particle size distribution, ambient PM10 sampling data (or other technologies), as well as videos of OD events and/or other measurements to quantify OD cloud heights.

5.0 REFERENCES

DNA (Defense Nuclear Agency), October 1981. High Explosives Field Tests - Explosive Phenomena and Environmental Impacts. AD/A 135737. Washington, DC.

LLL (Lawrence Livermore Laboratory), September 1976. Estimate of Crater Dimensions for Near-Surface Explosions of Nuclear and High-Explosive Sources, Livermore, CA.

U.S. Army, June 1980. ASL-DUST: A Tactical Battlefield Dust Cloud and Propagation Code, U.S. Army Electronics Research and Development Command, Atmospheric Sciences Laboratory, White Sands Missile Range, NM.

U.S. Army, January 1981. Electro-Optical Systems Atmospheric Effects Library, U.S. Army Electronics Research and Development Command, White Sands Missile Range, NM.

U.S. Army, October 1987. Combined Obscuration Model for Battlefield-Induced Contaminants, COMBIC, U.S. Army Laboratory Command, Atmospheric Sciences Laboratory, White Sands Missile Range, NM.

U.S. Army, January 1992. Final Report: Development of Methodology and Technology for Identifying and Quantifying Emissions Products from Open Burning and Open Detonation Thermal Treatment Methods. U.S. Army Armament, Munitions and Chemical Command. Rock Island, IL.

U.S. Army, 1993. Air Pathway Screening Assessments for RCRA Subpart X Permitting. Army Environmental Center, Aberdeen, MD.

APPENDICES

APPENDIX A

OD DUST CLOUD SUSPENDED PARTICULATE CONCENTRATIONS

(U.S. Army, January 1992)

Table 4.2.3 Summary of Total Particulate Mass Concentrations for Surface and Suspended TNT Detonations.

Test	Particulate Mass Concentration (mg/m^3)			
	Minimum	Maximum	Average	No. of Filter Samples
Phase A - surface	24	65	45	2
Phase B - surface	35	85	62	3
Phase C - surface	248	268	258	2
Phase B - Suspended	8	16	11	3
Phase C - Suspended	37	37	37	1

Table 4.2.18 Average Particulate Matter Concentrations Measured During Multiple Aircraft Sampling Passes of Composition-B Detonation Clouds.

Test Event	Particulate Matter Concentration (mg/m^3)
Composition-B - first 3-detonation series	218
Composition-B - second 3-detonation series	191

Table 4.2.26 Average Particulate Matter Concentrations Measured During Multiple Aircraft Sampling Passes of Explosive-D Detonation Clouds.

Test Event	Particulate Matter Concentration (mg/m^3)
Explosive-D - First 3-detonation series	184
Explosive-D - Second 3-detonation series	315

Table 4.2.34 Average Particulate Concentrations Measured During Multiple Aircraft Sampling Passes of RDX Detonation Clouds.

Test Event	Particulate Matter Concentration (mg/m^3)
RDX - first 3-detonation series	242
RDX - second 3-detonation series	179

APPENDIX B

OD CRATER
DIMENSIONS

(U.S. Army, January 1992)

Table 4.2.8 OB/OD Detonation Crater Dimension, Volume, and Weight of Displaced Soil.

Location	Rim Opening (m)	Depth (m)	Volume (m^3)	Weight of Soil (kg)	Average Weight (kg)
TNT Surface Detonations-Phase B					
1	5.6	2.1	30.71	76777	
[illegible]	4.9	1.7	18.60	46503	
[illegible]	5.3	1.3	15.49	38726	
4	5.0	1.8	20.73	51813	
5	6.5	2.2	42.08	105192	
6	ND[a]	1.9	ND	ND	
7	ND	1.4	ND	ND	
TNT Surface Detonations-Phase C					
C1	4.3	1.4	11.60	29005	
C2	4.6	1.6	15.44	38600	
C3	6.7	1.8	34.78	86961	
C4	4.5	1.7	16.09	40228	
C5	ND	ND	ND	ND	
C6	4.3	1.7	14.92	37290	
C0	5.3	2.0	26.25	65627	56066

[a]ND - no data.

Table 4.2.21 OB/OD Detonation Crater Dimension, Volume, and Weight of Displaced Soil for Composition B.

Location	Rim Opening (m)	Depth (m)	Volume (m^3)	Weight of Soil (kg)	Average Weight (kg)
Composition B					
B0	5.0	2.0	23.82	59559	
B1	ND[a]	ND	ND	ND	
B2	5.0	1.9	22.24	55611	
B3	5.5	2.0	27.95	69868	
B4	5.0	2.0	23.82	59559	
B5	ND	ND	ND	ND	
B6	5.5	2.0	27.95	69868	
D0	5.5	2.0	27.95	69868	64056

[a]ND - no data.

Table 4.2.29 OB/OD Detonation Crater Dimension, Volume, and Weight of Displaced Soil for Explosive D.

Location	Rim Opening (m)	Depth (m)	Volume (m^3)	Weight of Soil (kg)	Average Weight (kg)
Explosive D					
A1	7.5	2.0	48.37	120919	
A2	7.4	2.2	52.88	132211	
A3	6.7	2.1	41.87	104671	
A4	6.9	2.3	49.37	123431	
A5	6.5	2.0	37.37	93430	
A6	7.0	2.0	42.67	106683	113557

Table 4.2.37 OB/OD Detonation Crater Dimension, Volume, and Weight of Displaced Soil for RDX.

Location	Rim Opening (m)	Depth (m)	Volume (m^3)	Weight of Soil (kg)	Average Weight (kg)
RDX Explosive					
D1	6.5	1.5	26.65	66636	
D2	6.5	1.2	20.81	52037	
D3	6.0	1.5	22.97	57432	
D4	6.5	1.5	26.65	66636	
D5	6.5	2.0	37.37	93430	
D6	6.5	1.5	26.65	66636	67135

APPENDIX C

DPG SOIL DATA

Chen-Northern, Inc.

350 West 2700 South
Salt Lake City, Utah 84115
801/487-3661

Billings
Boise
Casper
Colorado Springs
Denver
Elko
Evanston
Gilette
Glenwood Springs
Great Falls
Helena
Phoenix
Pocatello
Rock Springs
Salt Lake City
San Antonio
Tri Cities
Yakima

June 21, 1989

Lockheed
P.O. Box 217
Dugway, Utah 84022

Attention: Jim Keetch

Subject: Drilling and Sampling Services
OB/OT Project
Dugway Proving Ground
Dugway, Utah
Job No. 5-344-89

Gentlemen:

As requested, Chen-Northern, Inc. performed drilling and sampling for your OB/OT Project at Dugway Proving Grounds, Utah. This letter presents the results of our drilling and sampling program.

Site Conditions

The site is located at Dugway Proving Grounds at the location shown on the attached Figure. The site is located near the bottom of the valley and is relatively flat with a gentle slope to the east. Occasional small dry drainages cross the site, which are approximately 1 to 2 feet in depth. Vegetation consists of sparse grass and brush.

Subsoil Conditions

Subsoil conditions at the site were investigated by drilling 5 exploratory borings at the locations shown on the second figure attached. Borings were advanced using a truck mounted rotary drill equipped with 7-inch diameter hollowstem augers. Sampler and drilling equipment were steam cleaned between samples and holes to prevent cross-contamination. A material safety data sheet of the detergent used for cleaning the drilling equipment is attached. Two inch outside diameter standard split spoon samples were obtained from borings at the time of drilling. Borings were continuously sampled and advanced to a total depth of 12 feet.

At the time of the investigation, the soils were visually classified and logged by a geologist from Chen-Northern, Inc. As

requested, samples were transmitted to you at the site. Logs of the borings are attached.

Subsoil conditions encountered within the borings consisted of an upper 4 feet of interlayered silty sand and silts, overlying clay soils to a depth of approximately 9 feet. Silty sands were found to extend below the clay for the full depth of the borings, 12 feet.

The interlayered silts and sands were generally in a loose to medium dense condition. Moisture condition of the soil ranged from dry to moist and color was generally light brown. The interlayered soils were occasionally calcareous and contained occasional roots in the upper portion.

The clays were slightly silty and soft to medium stiff. The clays were very moist to wet with a white to light brown to light gray color and iron oxide staining. Occasional roots were encountered in the clay.

The lower sand encountered within the borings was silty, in a medium dense and moist condition. The sands were generally brown in color with iron oxide staining.

Free water was encountered within the exploratory borings at depths ranging from 6 to 9 feet below existing grade.

If you have any questions, or if we can be of further service, please call.

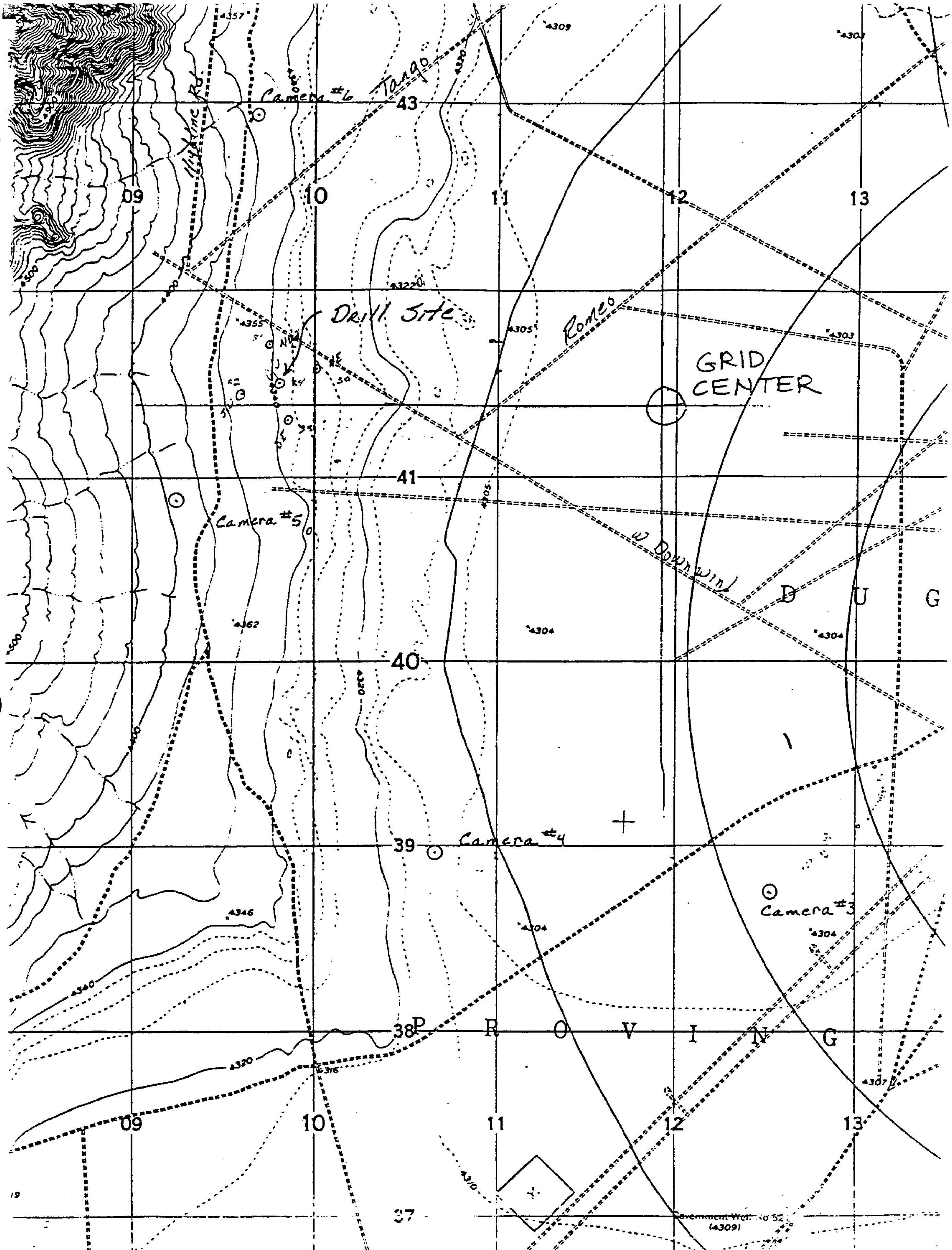
Sincerely,

CHEN-NORTHERN, INC.

Douglas R. Hawkes

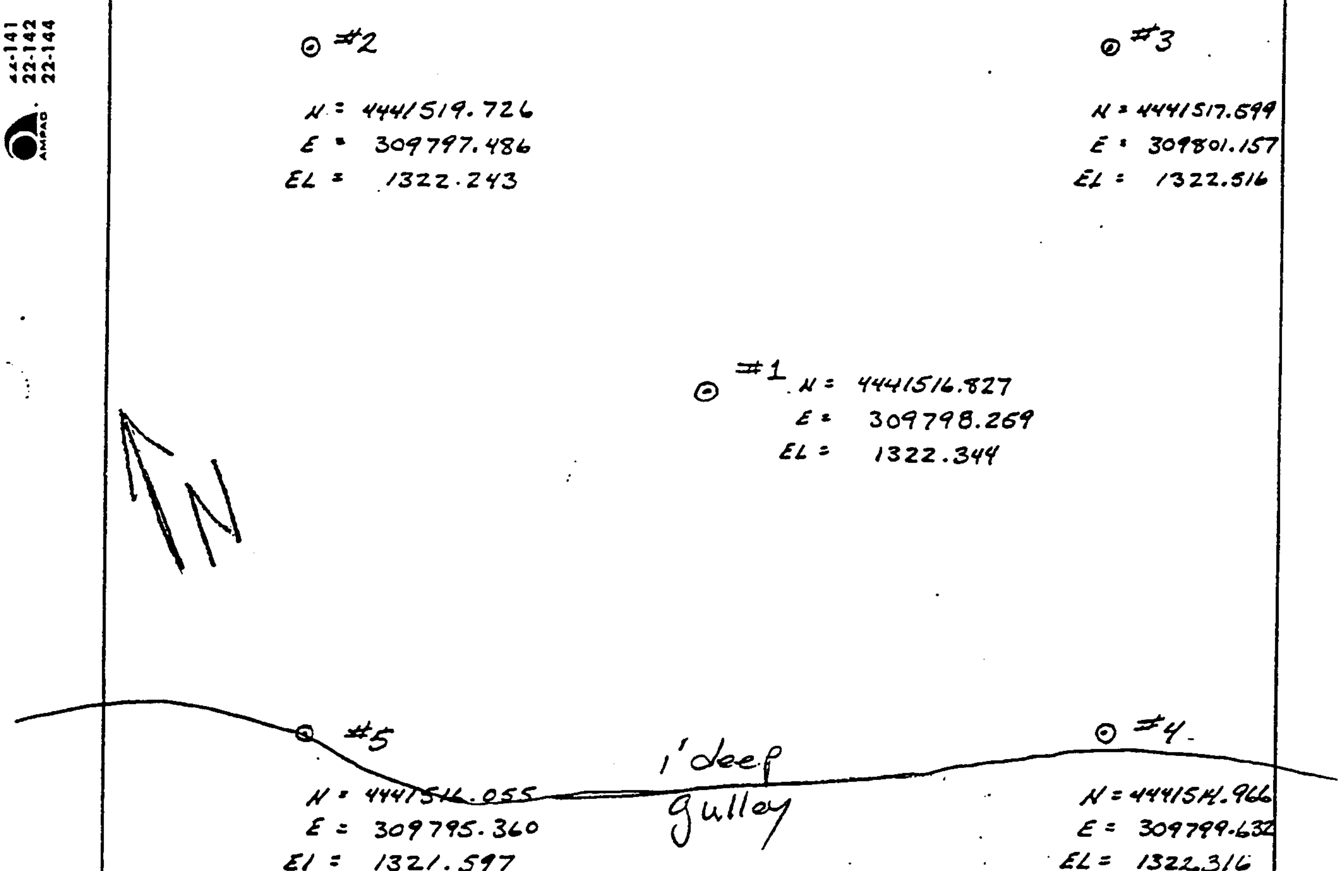
Douglas R. Hawkes

DRH/cs
Rev. by JEN, P.E.
cc: John Woffinden



Camera #6
Tango
Camera #5
Camera #4
Camera #3
Drill Site
Romeo
GRID CENTER
w Downwind
Midline Rd.
D U G
P R O V I N G
09
10
11
12
13
43
41
40
39
38
37
4357
4309
4303
4322
4355
4305
4362
4304
4346
4340
4320
4316
4307
4310
4300
4500
Government Well No 52
(4309)

OBOD Core Sample Locations



CHEN AND ASSOCIATES, INC.

LOG OF HOLE B-1 JOB NAME Dugway Proving Ground PAGE 1 OF 1

JOB NO. 534489 DRILLING METHOD 7" Hollow Stem Auger ENGINEER Bill R

HOLE ELEVATION ______ RIG/DRILLER B& mobil / Interstate

DATE/TIME 6/1/89 10:10 – 11:20

HOLE LOCATION center boring

GROUND WATER OBSERVATIONS

WATER LEVEL	85"-106"	
DATE	6-1-89	
TIME	10:45	

DEPTH FROM	DEPTH TO	SOIL SYMBOL	SOIL DESCRIPTION AND DRILLING CONDITIONS
0	48"	mL/Sm	Varied: Silty - Very Silty Sand (Fine) to Sandy Silt (Fine), medium - stiff, dry @ surface - moist below, Light brown, roots, mica flakes, occ. Calcareous spots
48"	108"	CL	Slightly silty clay, soft, very moist - wet below Bone white - Light Brown - Light gray, stratified, roots above slight Fe staining.
108"	144"	SM	Silty Sand, medium dense, moist, Brown, slight Fe staining, slightly stratified.

DEPTH TO TOP (FEET)	BLOW COUNT	TYPE SAMPLE	SOIL SYM.	DRY	MOIST	WET	SOFT	FIRM	HARD	PEN. (TSF)	% SAND GRAVEL	% FINES (-200)	FINE	MEDIUM	COARSE	GRAVEL	COLOR	LOW	MEDIUM	HIGH	CEMENTED	FRACTURED	STRAT.	BLOCKY	POROUS	CALC.	OTHER	RECOVERY
				MOISTURE			FIRMNESS						GRADING					PLASTIC			CONDITION							
0	4.5.7	SPT	mL/Sm		S			X			40	60	X	S			Lt Brn	N					mica				roots	18
18"	5.4.4		Sm/mL		S			X			60	40	X	S			"	N					mica			X	roots	18
36"	4.2.3		CL/mL		X		X				25	75	X				" + Bone wht		X			mica				X	roots	18
54"	2.2.3		CL		V		X				5	95	S				Lt Gray		X				X					18
72"	2.2.1		CL		V		X				0	100					"		X				V	4"			sluffed top/roots	18
90"	1.1.1		CL			X	X				0	100					"		X				V	4"			sluffed top	18
108"	6.6.8		Sm		X						85	15	X	X	X		Brn	N					S	6"			sluffed top	14
126"	7.11.19		Sm		X						85	15	X	X	X		Brn							7"			sluffed top	14

N = NON
S = SLIGHTLY
M = MODERATELY
H = HIGHLY
V = VERY

CAL = CALIFORNIA
SS = SPLIT SPOON
ST = SHELBY TUBE
D = DISTURBED BULK
P = PITCHER

DEPTH TO BEDROCK —
DEPTH TO CAVE —
PVC CASING (DEPTH/DIAM) ______
BOTTOM HOLE DEPTH 12.0'

CHEN AND ASSOCIATES, INC.

LOG OF HOLE B-2 JOB NAME Dugway Proving grounds PAGE 1 OF

JOB NO. 534481 DRILLING METHOD 7" hollow Stem Auger ENGINEER Bill R

HOLE ELEVATION RIG/DRILLER B61 Mobile

DATE/TIME 5/31/89 12:30 - 2:15

HOLE LOCATION NW boring

GROUND WATER OBSERVATIONS

WATER LEVEL	72-108"		
DATE	5/31/89		
TIME			

DEPTH FROM	DEPTH TO	SOIL SYMBOL	SOIL DESCRIPTION AND DRILLING CONDITIONS
0	47"	SM/ML	Varied: Fine Sandy Silt to Silty - Very Silty Fine Sand, medium - STIFF, dry @ surface - moist below, Light brown, roots, mica Flakes, occ. calcium Spots
47"	106"	CL	Slightly silty Clay, soft, very moist - wet below, Bone white / Light brown - Light gray, stratified, roots, slight Fe Staining,
106"	144"	SM	silty Sand, medium dense, moist brown, slight Fe Staining, Slightly stratified.
			Pressure spray w/Power Scrub 1040 and then w/Clean Water

DEPTH TO TOP (FEET)	BLOW COUNT	TYPE SAMPLE	SOIL SYM.	MOISTURE: DRY	MOIST	WET	FIRMNESS: SOFT	FIRM	HARD	PEN. (TSF)	% SAND GRAVEL	% FINES (-200)	GRADING: FINE	MEDIUM	COARSE	GRAVEL	COLOR	PLASTIC: LOW	MEDIUM	HIGH	CONDITION: CEMENTED	FRACTURED	STRAT.	BLOCKY	POROUS	CALC.	OTHER	RECOVERY
0	4-7-6	SPT	ML/SM		S			X			40	60	X	S			Lt Brn	N				mica					roots	18
18"	6-8-9	SPT	SM/ML		X			X			60	40	X	X	X		"	N	mica,			1/4" max	sand				roots	18
36"	6-5-4	SPT	CL/ML/SM		X			X			35	65	X	X	X		" + Bone		X				X			X	roots	18
54"	4-3-2	SPT	CL		V			X			10	90	X	S	S		Bone + Gray		X				X			X	roots	18
72"	2-1-2	SPT	CL			X	X				0	100					Lt Gray		X				V				sandy burrows	18
90"	1-5-7	SPT	CL/SM			X	X	X			25	75	X	X	X		"		X				V		moist		sm@ 92"	18
108"	8-12-15	SPT	SM		V			X			80	20	X	X	X	S	Gray-Brn	N					S	6" CL			sluff @ top	18
126	18-38-52	SPT	SM		V				X		85	15	X	X	X	S	Brn	N					S		"		" "	18

N = NON
S = SLIGHTLY
M = MODERATELY
H = HIGHLY
V = VERY

CAL = CALIFORNIA
SS = SPLIT SPOON
ST = SHELBY TUBE
D = DISTURBED BULK
P = PITCHER

DEPTH TO BEDROCK
DEPTH TO CAVE
PVC CASING (DEPTH/DIAM.)
BOTTOM HOLE DEPTH 12.0'

CHEN AND ASSOCIATES, INC.

LOG OF HOLE R-3 JOB NAME Dugway Proving grounds PAGE 1 OF 1

JOB NO. 534489 DRILLING METHOD 4" hollow stem auger ENGINEER R. F

HOLE ELEVATION ______ RIG/DRILLER B61 mobil/ Stat

DATE/TIME 5/31/89 2:20 - 3:35

HOLE LOCATION NE Spring

GROUND WATER OBSERVATIONS			
WATER LEVEL	80" - 106"		
DATE	5-31-89		
TIME	3:00		

DEPTH FROM	DEPTH TO	SOIL SYMBOL	SOIL DESCRIPTION AND DRILLING CONDITIONS
0	48"	ML-CL	Varied: Sandy silt to silty - very silty sand medium - stiff, dry @ surface - moist below, light brown, roots, mica flakes occ. calcareous spots
48"	107"	CL	Slightly silty clay, soft, very moist - wet below, bone white - light brown - light gray stratified, roots, slight Fe staining
107"	144"	SM	Silty sand, medium dense, moist, brown slight Fe staining, slightly stratified

DEPTH TO TOP (FEET)	BLOW COUNT	TYPE SAMPLE	SOIL SYM.	MOISTURE: DRY	MOISTURE: MOIST	MOISTURE: WET	FIRMNESS: SOFT	FIRMNESS: FIRM	FIRMNESS: HARD	PEN. (TSF)	% SAND GRAVEL	% FINES (-200)	GRADING: FINE	GRADING: MEDIUM	GRADING: COARSE	GRADING: GRAVEL	COLOR	PLASTIC: LOW	PLASTIC: MEDIUM	PLASTIC: HIGH	CONDITION: CEMENTED	CONDITION: FRACTURED	CONDITION: STRAT.	CONDITION: BLOCKY	CONDITION: POROUS	CONDITION: CALC.	OTHER	RECOVERY
0	3.3.3	SPT	ML		S			X			35	65	X				Lt Brn	N					Mica			Flakes,	roots	18
18"	7.7.5		ML/SM		X			X			50	50	X	S			"	N				Mica				X	roots	18
36"	5.3.4		CL/ML		X			X			15	85	S	S			"		X				S				roots	18
54"	2.2.3		CL		V		X				15	85	S	S			Bone + Lt Brn		X				X			X	mica, roots	18
72"	3.3.2		CL			X	X				0	100					"		X				V				roots	12
90"	1.1.4		CL/SM			X					10	90	X	X	X		"		X				V	moist sm @ bb Hdm			roots	18
108"	9.9.16		SM		X						85	15	X	X	X		Brn	N					S			8"	CL slaff @ Top.	18"
126"	10.26.36	V	SM		X						85	15	X	X	X	S	Brn	N					S			9"	" "	18"

N = NON
S = SLIGHTLY
M = MODERATELY
H = HIGHLY
V = VERY

CAL = CALIFORNIA
SS = SPLIT SPOON
ST = SHELBY TUBE
D = DISTURBED BULK
P = PITCHER

DEPTH TO BEDROCK ______
DEPTH ______
PVC CASING ______
BOTTOM OF HOLE 12.0

CHEN AND ASSOCIATES, INC.

LOG OF HOLE B-4 JOB NAME Dugway Proving Grounds PAGE 1 OF 1

JOB NO. 534439 DRILLING METHOD 7" hollow stem auger ENGINEER [illegible]

HOLE ELEVATION ______ RIG/DRILLER 36' mobil / Interstate

DATE/TIME 6/1/89 9:55 - 10:05

HOLE LOCATION SE corner

GROUND WATER OBSERVATIONS

WATER LEVEL	90 - 107"		
DATE	6-1-89		
TIME	10:00		

DEPTH FROM	DEPTH TO	SOIL SYMBOL	SOIL DESCRIPTION AND DRILLING CONDITIONS
0	48"	ml/sm	Varied: Silty - very silty sand (fine) to sandy (fine) silt, medium - stiff, dry @ surface - moist below, light brown, roots, mica flakes, occ calcareous spots
48"	108"	CL	Slightly silty clay, soft, very moist - wet below, bone white - light brown - light gray, stratified, roots, slight Fe staining
108	144"	sm	Silty sand, medium dense, moist, brown, slight Fe staining, slightly stratified

DEPTH TO TOP (FEET)	BLOW COUNT	TYPE SAMPLE	SOIL SYM.	MOISTURE: DRY	MOISTURE: MOIST	MOISTURE: WET	FIRMNESS: SOFT	FIRMNESS: FIRM	FIRMNESS: HARD	PEN. (TSF)	% SAND GRAVEL	% FINES (-200)	GRADING: FINE	GRADING: MEDIUM	GRADING: COARSE	GRADING: GRAVEL	COLOR	PLASTIC: LOW	PLASTIC: MEDIUM	PLASTIC: HIGH	CONDITION: CEMENTED	CONDITION: FRACTURED	CONDITION: STRAT.	CONDITION: BLOCKY	CONDITION: POROUS	CONDITION: CALC.	OTHER	RECOVERY
0	3-7-10	SPT	Sm/ml		S			X			60	40	X	X			Lt Brn	V				mica				S	roots	18
18"	7-9-10		Sm/ml		S			X			60	40	X	X	X		"	N				mica				S	roots	18
36"	10-4-5		ml/CL		X			X			85	15	S	S			"		X			mica				X	rook	12
54"	10-5-23		cl/..		X			X			10	90	X	S			" + Bone		X				X				roots	13
72"	2-1-2		CL		V		X				0	100					Bone		X				X				roots	15
90"	1-1-2		CL			X	X				0	100					Bone + Lt Brn		X				V	Sm @ Bottom			roots	12
108"	9-11-14		Sm		X			Y			85	15	X	X	X		Lt Brn	N								9'	CL Stiff @ Top	18'
126"	4-8-17		Sm		X			X			85	15	X	X	X		Brn	N					S			11'	CL + Sm' Stiff @ top	18'

N = NON
S = SLIGHTLY
M = MODERATELY
H = HIGHLY
V = VERY

CAL = CALIFORNIA
SS = SPLIT SPOON
ST = SHELBY TUBE
D = DISTURBED BULK
P = PITCHER

DEPTH TO BEDROCK ______
DEPTH TO CAVE ______
PVC CASING (DEPTH/DIAM) ______
BOTTOM HOLE DEPTH 12.0'

CHEN AND ASSOCIATES, INC.

LOG OF HOLE B-5 JOB NAME Dugway Proving Grounds PAGE 1 OF 1

JOB NO. 534489 DRILLING METHOD 7" hollow Stem Auger ENGINEER R... [illegible]

HOLE ELEVATION ______ RIG/DRILLER B61 mobil / Interstate

DATE/TIME 6/1/89 11:20

HOLE LOCATION SW corner

GROUND WATER OBSERVATIONS

WATER LEVEL	85 - 110"		
DATE	6-1		
TIME			

DEPTH FROM	DEPTH TO	SOIL SYMBOL	SOIL DESCRIPTION AND DRILLING CONDITIONS
0	49"	ML/SM	Varied: Sandy (fine) Silt to Silty - very fine Sand (fine), medium-stiff, dry @ surface - moist below, light brown, roots, mica flakes, occ. calcareous spots
49"	110"	CL	Slightly silty clay, soft, very moist - wet below, banded white - light - brown - light gray, stratified, roots, slight Fe staining
110"	144"	SM	Silty sand, medium dense, moist, brown, slightly stratified, slight Fe staining

DEPTH TO TOP (FEET)	BLOW COUNT	TYPE SAMPLE	SOIL SYM.	MOISTURE: DRY	MOISTURE: MOIST	MOISTURE: WET	FIRMNESS: SOFT	FIRMNESS: FIRM	FIRMNESS: HARD	PEN (TSF)	% SAND GRAVEL	% FINES (-200)	GRADING: FINE	GRADING: MEDIUM	GRADING: COARSE	GRADING: GRAVEL	COLOR	PLASTIC: LOW	PLASTIC: MEDIUM	PLASTIC: HIGH	CONDITION: CEMENTED	CONDITION: FRACTURED	CONDITION: STRAT.	CONDITION: BLOCKY	CONDITION: POROUS	CONDITION: CALC.	OTHER	RECOVERY
0	3-4-5	SPT	ML/SM		S			X			40	60	X	S			Lt Brn	N	-				mica				roots	18
18"	6-4-5		ML		S			X			35	65	X	S			"	N						1" sluff			roots	18
36"	6-4-4		SM/ML/CL		X			X			40	60	X	S			" brown		X				S			X	roots	16
54"	6-3-4		CL		V		X				10	90	S	S			Brn + Gray		X				X		ML above		roots	17
72"	2-2-2		CL		V		X				0	100					"		X				V				1" sluff	19
90"	1-1-1		CL			X	X				0	100					"		X				V				3" sluff	18
108"	3-8-8		CL/SM		X			X			50	50					"		CL X				X	SM below			3" sluff	18
126"	8-15-19		SM		X			X			85	15					Brn	N					S					1[illegible]

= NON
IGHTLY
ERATELY

CAL = CALIFORNIA
SS = SPLIT SPOON
ST = SHELBY TUBE
D = DISTURBED BULK
P = PITCHER

DEPTH TO BEDROCK ______
DEPTH TO CAVE ______
PVC CASING (DEPTH/DIAM) ______
BOTTOM HOLE DEPTH 12.0'

U.S. DEPARTMENT OF LABOR

Occupational Safety and Health Administration

Form Approved
OMB NO 44-R1387

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

CAS Reg. No. 77-92-9

MANUFACTURER'S NAME Hydro Engineering Inc.	EMERGENCY TELEPHONE NO (801) 972-1181
ADDRESS (Number, Street, City, State, and ZIP Code) 865 West 2600 South Salt Lake City, Utah 84119	
CHEMICAL NAME AND SYNONYMS	TRADE NAME AND SYNONYMS 1040
CHEMICAL FAMILY Alkaline Phorshate Det.	FORMULA Proprietary

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS	N/A		BASE METAL	N/A	
CATALYST	N/A		ALLOYS	N/A	
VEHICLE	N/A		METALLIC COATINGS	N/A	
SOLVENTS	N/A		FILLER METAL PLUS COATING OR CORE FLUX	N/A	
ADDITIVES	N/A		OTHERS	N/A	
OTHERS	N/A				

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
None		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)	215°	SPECIFIC GRAVITY (H_2O=1)	1.01
VAPOR PRESSURE (mm Hg.) H20=1	>1	PERCENT, VOLATILE BY VOLUME (%)	N/A
VAPOR DENSITY (AIR=1)	>1	EVAPORATION RATE (_____=1)	<1
SOLUBILITY IN WATER	100%	melting point	N/A
APPEARANCE AND ODOR Amber Color Light Musty			

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) N/A	FLAMMABLE LIMITS	Lel	Uel
EXTINGUISHING MEDIA Water, Foam, CO_2			
SPECIAL FIRE FIGHTING PROCEDURES Self Contained breathing appatatus for confined spaces.			
UNUSUAL FIRE AND EXPLOSION HAZARDS None known			

(Continued on reverse side)

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE	Not established
EFFECTS OF OVEREXPOSURE	Irritation to skin, Eyes, mucous membranes, nausea, vomiting upon ingestion.
EMERGENCY AND FIRST AID PROCEDURES	Skin, Eyes: Flush thoroughly with water for 15 min. if irritation persists consult physican. Ingestion: Copious amounts of water, induce vomiting. Consult physician.

SECTION VI- REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	
INCOMPATABILITY (Materials to avoid)	Strong Acids		
HAZARDOUS DECOMPOSITION PRODUCTS	Carbon Proxide & Carbon Monoxide		
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Collect & use if not contaminated

WASTE DISPOSAL METHOD

As locally required for Phosphate Detergents

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)	None required	
VENTILATION normal room ventilation is considered satisfactory.	LOCAL EXHAUST	SPECIAL
	MECHANICAL (General) Preferable	OTHER
PROTECTIVE GLOVES Rubber or Plastic	EYE PROTECTION Goggles	
OTHER PROTECTIVE EQUIPMENT	Eye wash & Safety shower	

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Irritant. Aviod unnecessary contact. Keep out of reach of children, Keep container closer when not in use. Aviod freezing.

OTHER PRECAUTIONS

OB/OD PHASE "C"

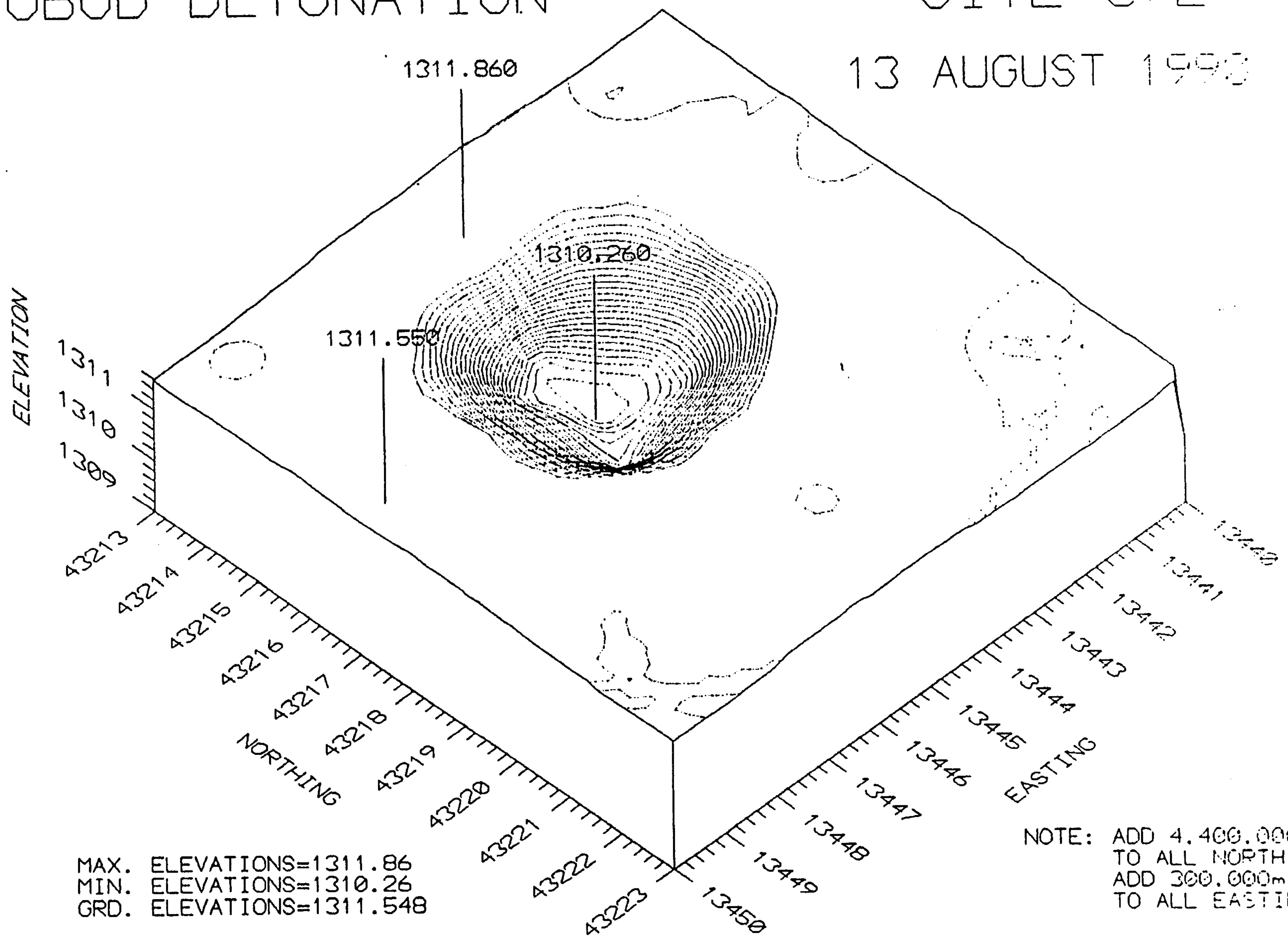
CRATER DIMENSIONS

LOCATION	RIM OPENING	DEPTH	COMMENTS
TNT SURFACE DETONATIONS			
C1	4.0	1.4	large clods- 10 to 12 in.
C2	4.5	1.6	"
C3	4.0	1.8	"
C4	4.5	1.7	"
C5	NOT MEASURED		
C6	4.5	1.7	"
C ORI	4.0	2.0	"
EXPLOSIVE D			
A1	7.5	2.0	small clods- fine dust
A2	7.5	2.2	"
A3	7.0	2.1	"
A4	8.5	2.3	"
A5	6.5	2.0	"
A6	7.0	2.0	"
COMPOSITION B			
B0	5.0	2.0	large clods- 10-12 in.
B1	NOT MEASURED		
B2	5.0	1.9	"
B3	5.5	2.0	"
B4	5.0	2.0	"
B5	NOT MEASURED		
B6	5.5	2.0	"
D ORI	5.5	2.0	"
RDX EXPLOSIVE			
D1	6.5	1.5	medium to large clods
D2	6.5	1.2	"
D3	6.0	1.5	"
D4	6.5	1.5	"
D5	6.5	2.0	"
D6	6.5	1.5	"

OBOD DETONATION

SITE C-2

13 AUGUST 199[illegible]



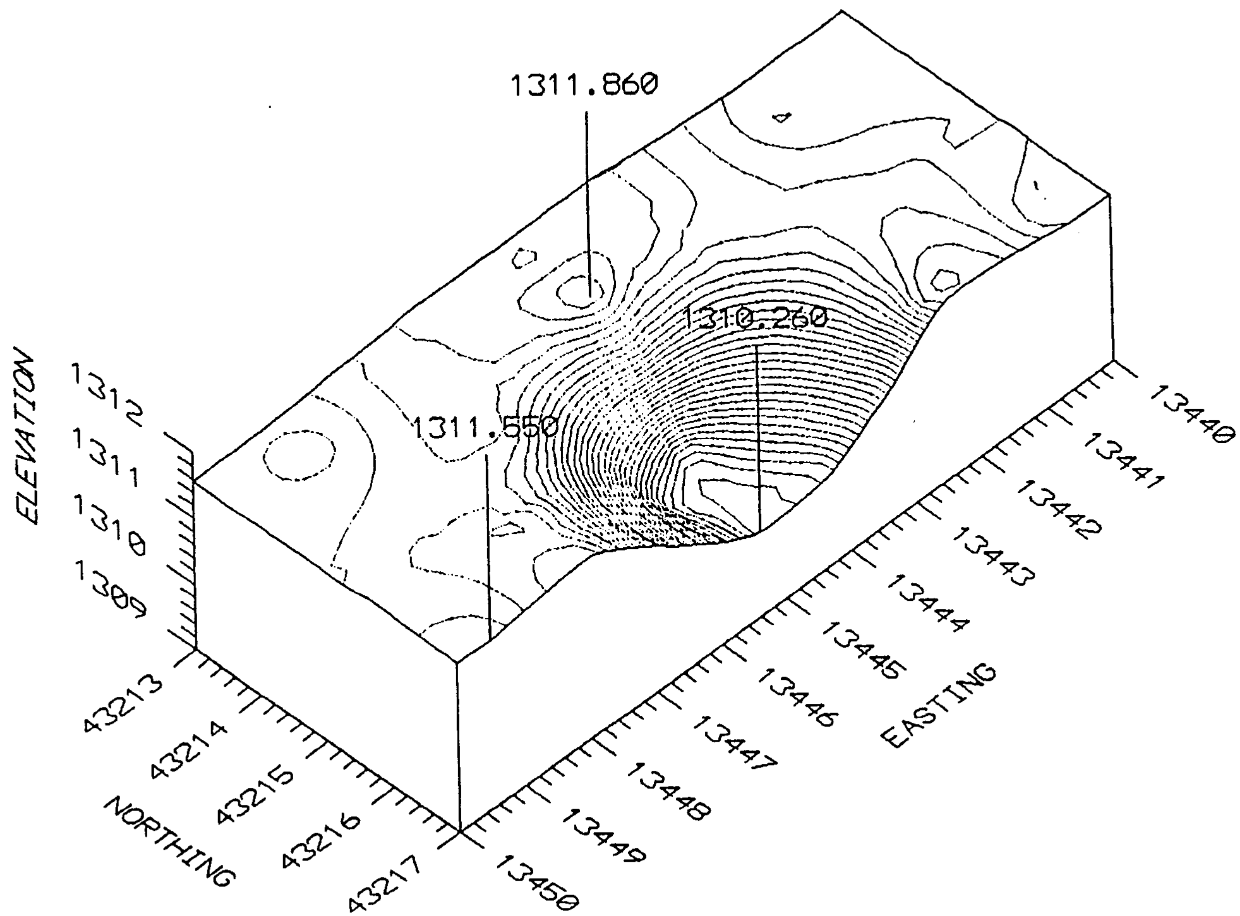
MAX. ELEVATIONS=1311.86
MIN. ELEVATIONS=1310.26
GRD. ELEVATIONS=1311.548

NOTE: ADD 4,400,000m TO ALL NORTHINGS. ADD 300,000m TO ALL EASTINGS.

OBOD DETONATION

SITE C-2

13 AUGUST 1990



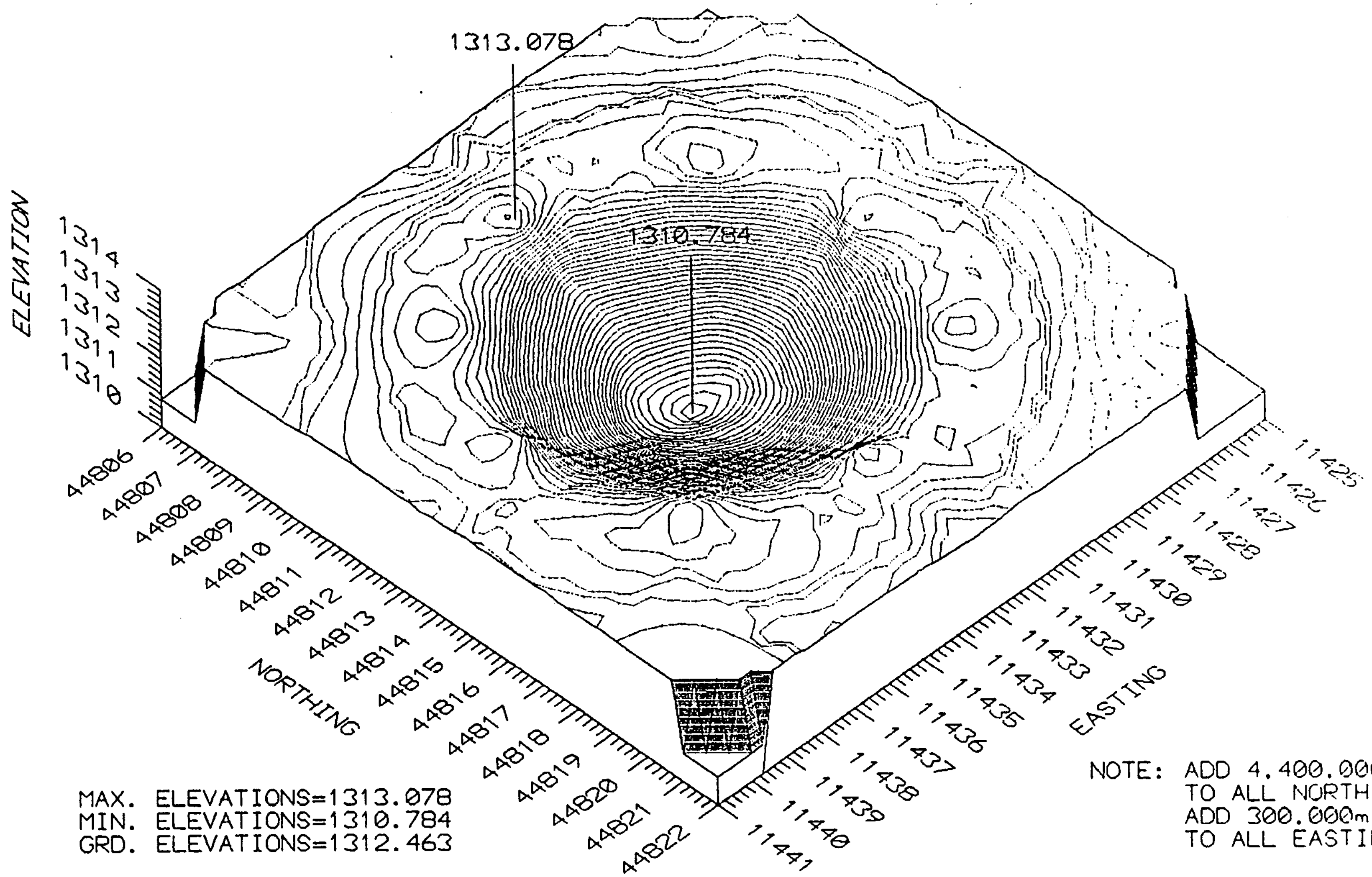
MAX. ELEVATIONS=1311.860
MIN. ELEVATIONS=1310.260
GRD. ELEVATIONS=1311.548

NOTE: ADD 4.400.000m TO ALL NORTHINGS. ADD 300.000m TO ALL EASTINGS.

OBOD DETONATION

SITE A-4

14 AUGUST 1990



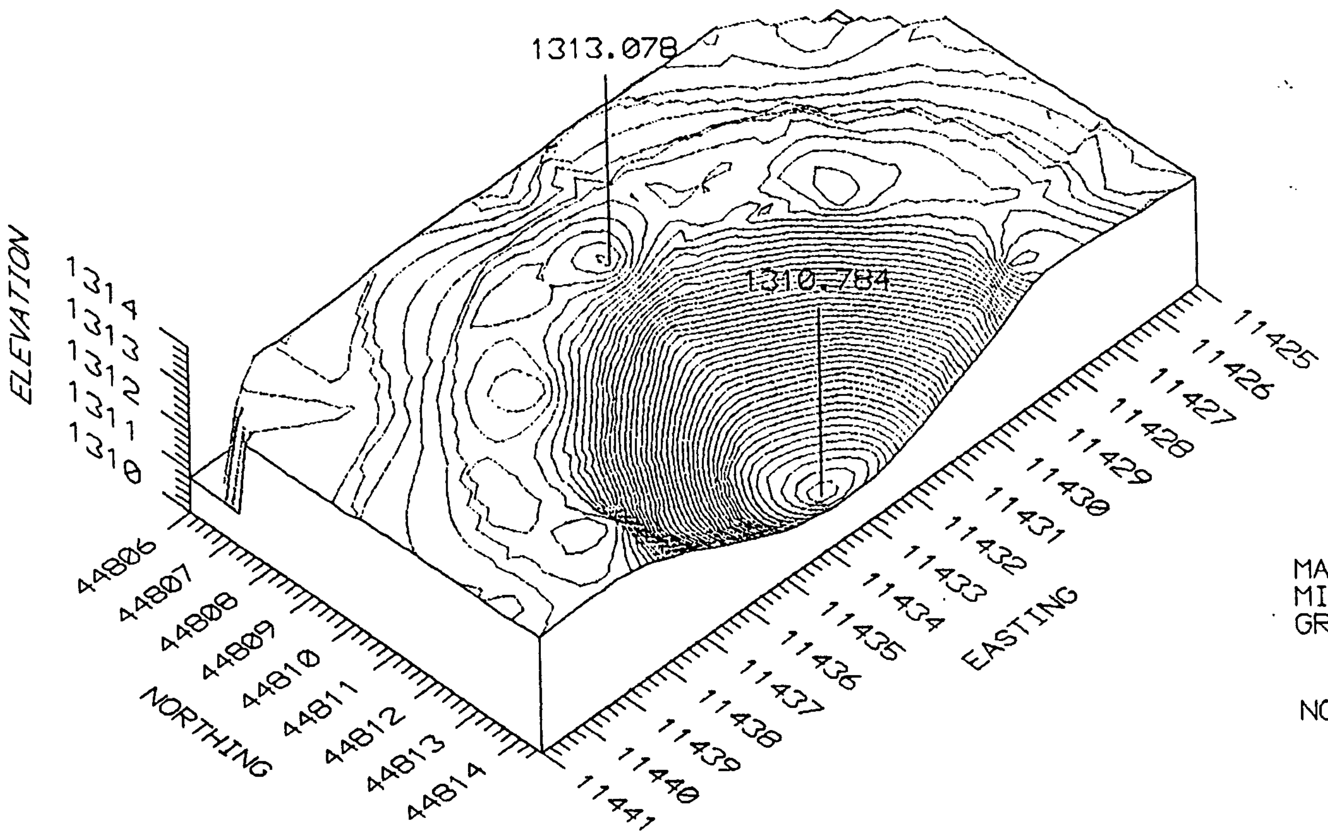
MAX. ELEVATIONS=1313.078
MIN. ELEVATIONS=1310.784
GRD. ELEVATIONS=1312.463

NOTE: ADD 4.400.000m TO ALL NORTHINGS. ADD 300.000m TO ALL EASTINGS.

OBOD DETONATION

SITE A-4

14 AUGUST 1990



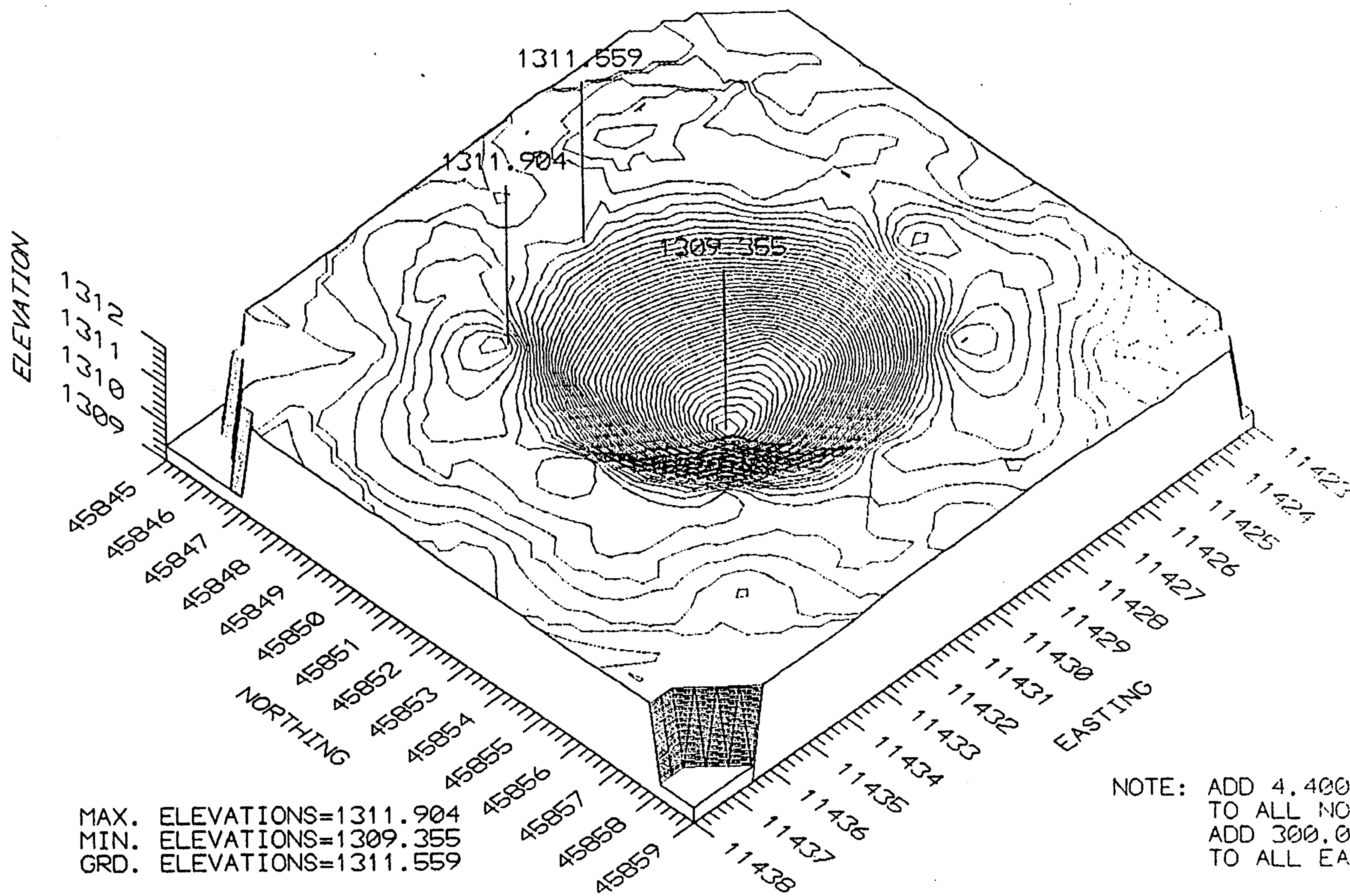
MAX. ELEVATIONS=1313.078
MIN. ELEVATIONS=1310.784
GRD. ELEVATIONS=1312.463

NOTE: ADD 4,400,000m TO ALL NORTHINGS.
ADD 300,000m TO ALL EASTINGS.

OBOD DETONATION

SITE A-2

14 AUGUST 1990



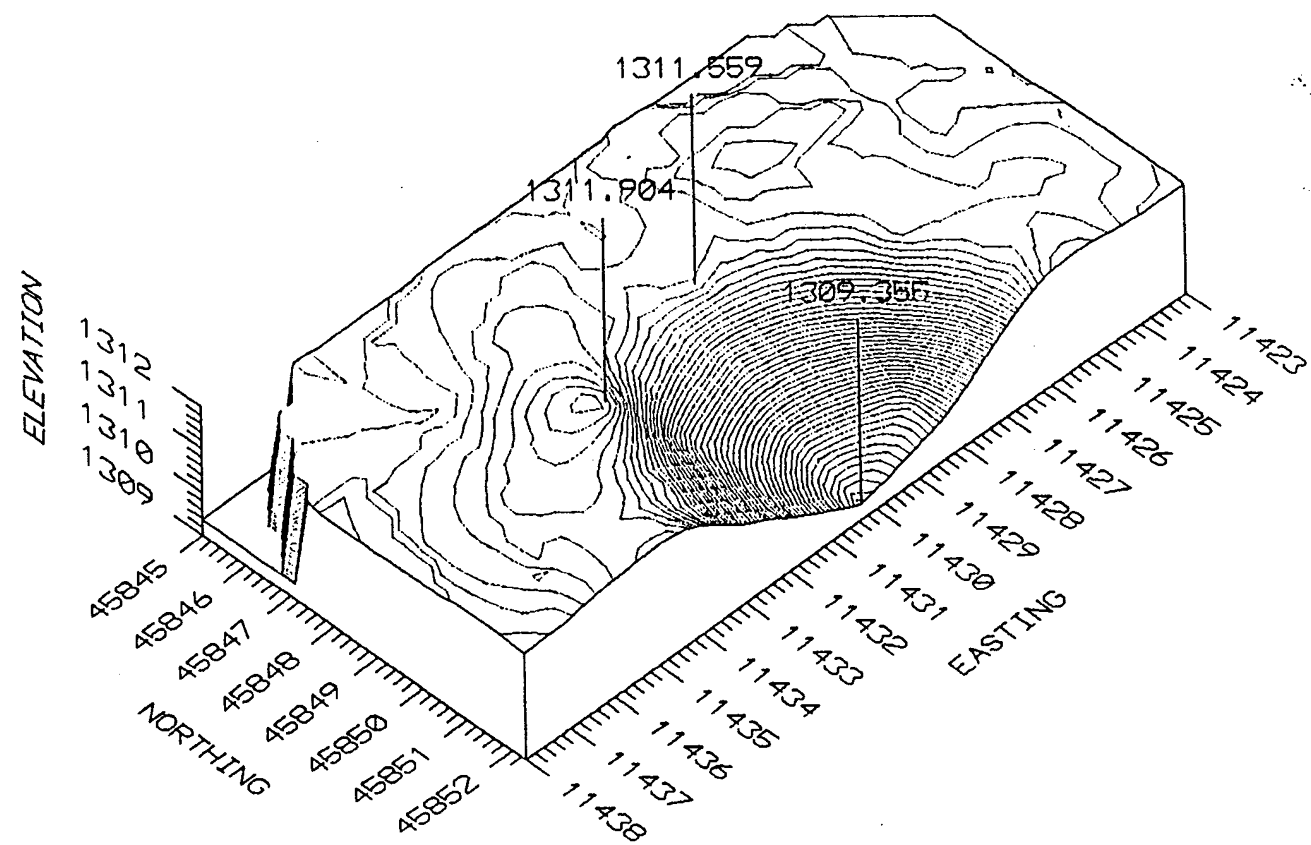
MAX. ELEVATIONS=1311.904
MIN. ELEVATIONS=1309.355
GRD. ELEVATIONS=1311.559

NOTE: ADD 4,400,000m TO ALL NORTHINGS. ADD 300,000m TO ALL EASTINGS.

OBOD DETONATION

SITE A-2

14 AUGUST 1990

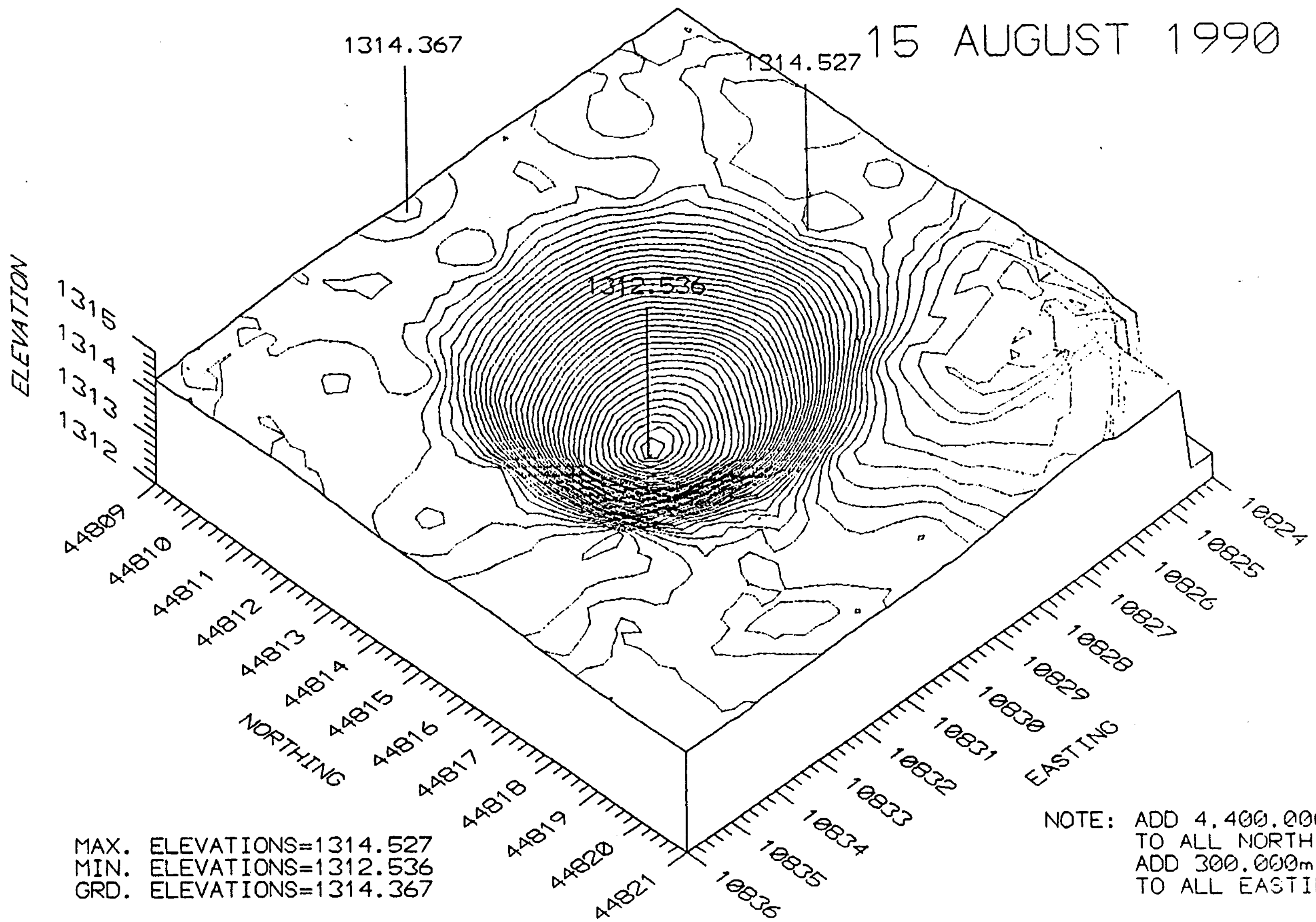


MAX. ELEVATIONS=1311.904
MIN. ELEVATIONS=1309.355
GRD. ELEVATIONS=1311.559

NOTE: ADD 4,400.000m TO ALL NORTHINGS.
ADD 300.000m TO ALL EASTINGS.

OBOD DETONATION — SITE A-5

15 AUGUST 1990



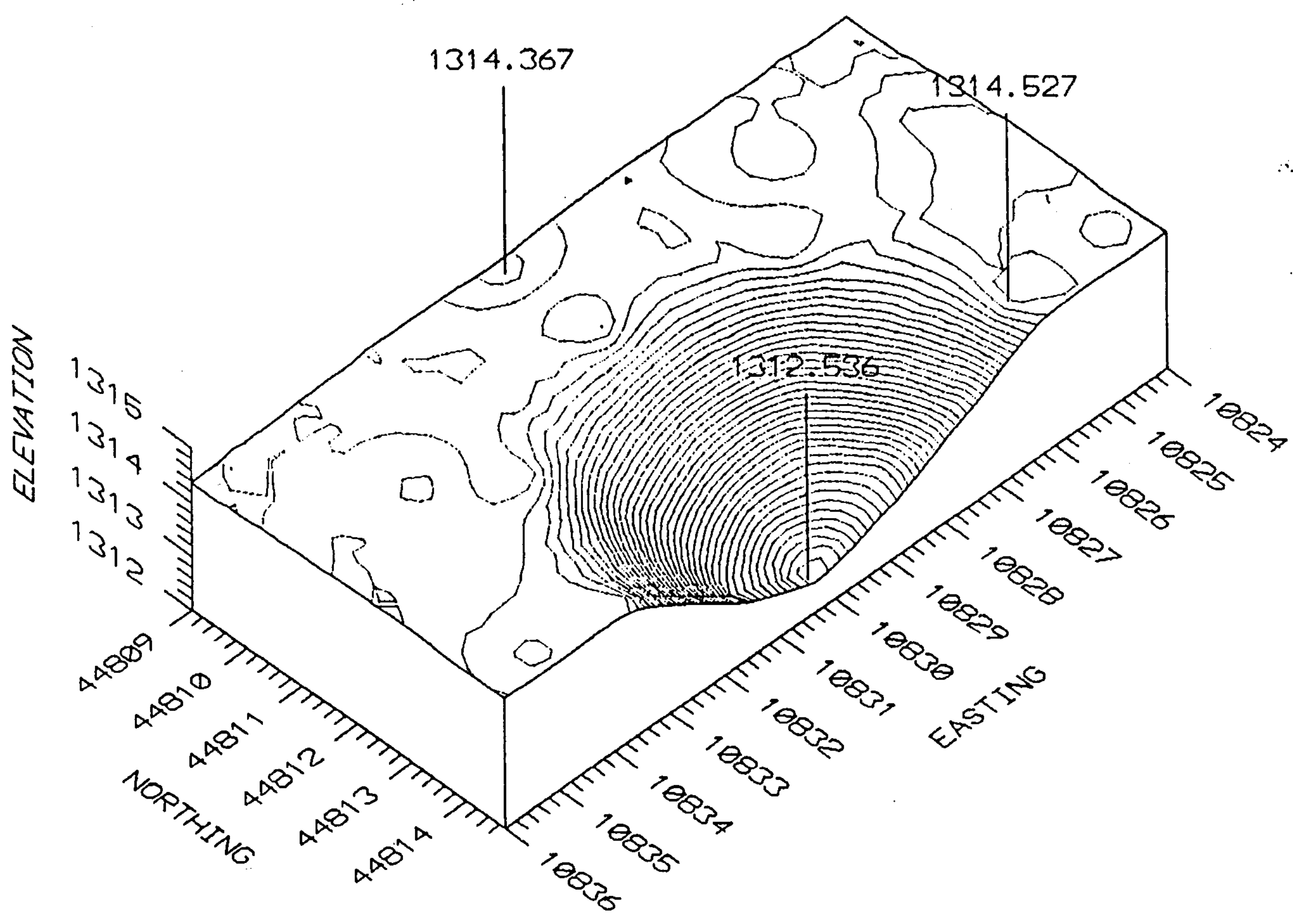
MAX. ELEVATIONS=1314.527
MIN. ELEVATIONS=1312.536
GRD. ELEVATIONS=1314.367

NOTE: ADD 4,400,000m TO ALL NORTHINGS. ADD 300,000m TO ALL EASTINGS.

OBOD DETONATION

SITE A-5

15 AUGUST 1990



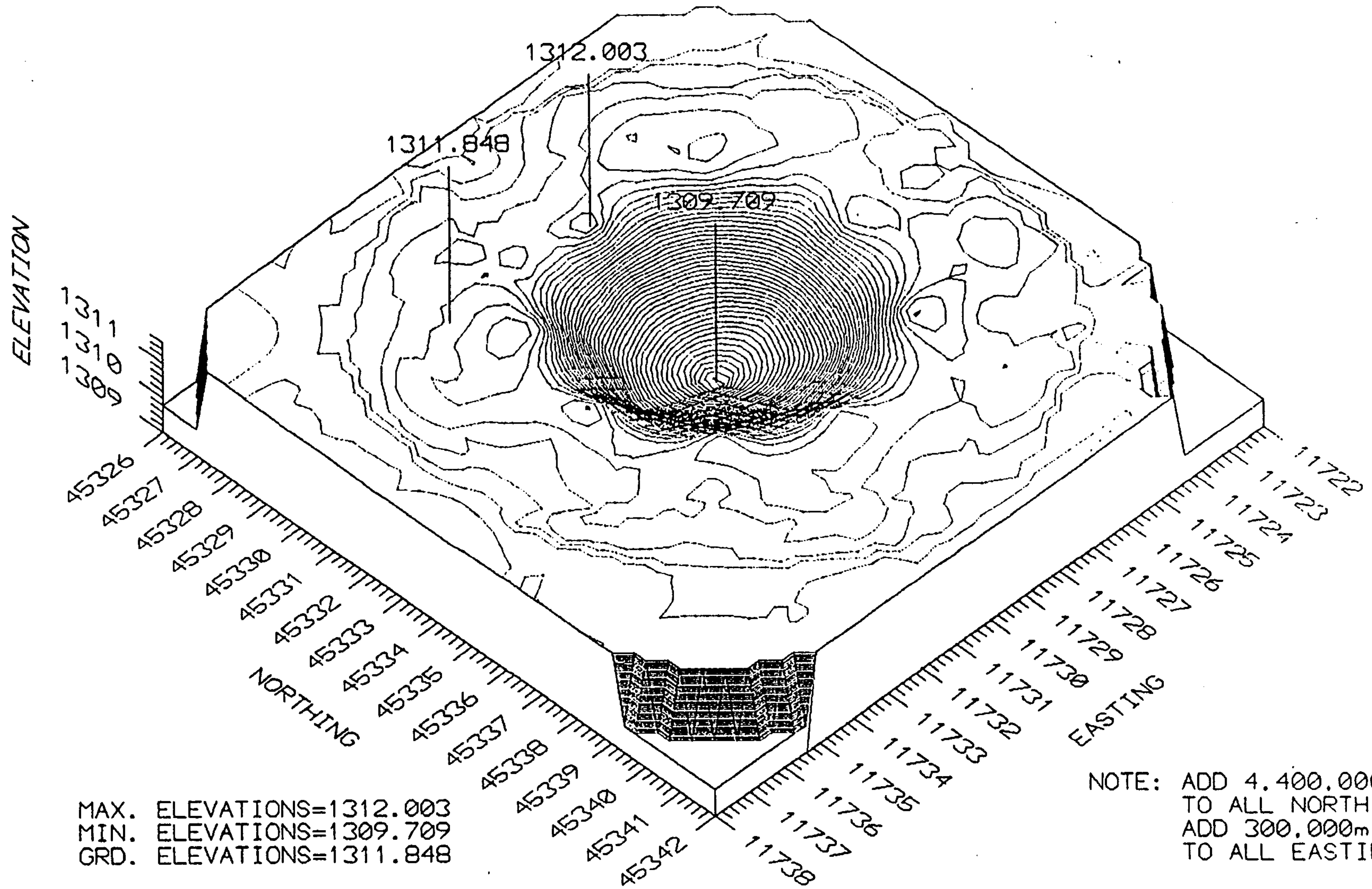
MAX. ELEVATIONS=1314.527
MIN. ELEVATIONS=1312.536
GRD. ELEVATIONS=1314.367

NOTE: ADD 4,400,000m TO ALL NORTHINGS.
ADD 300,000m TO ALL EASTINGS.

OBOD DETONATION

SITE A-3

15 AUGUST 1990



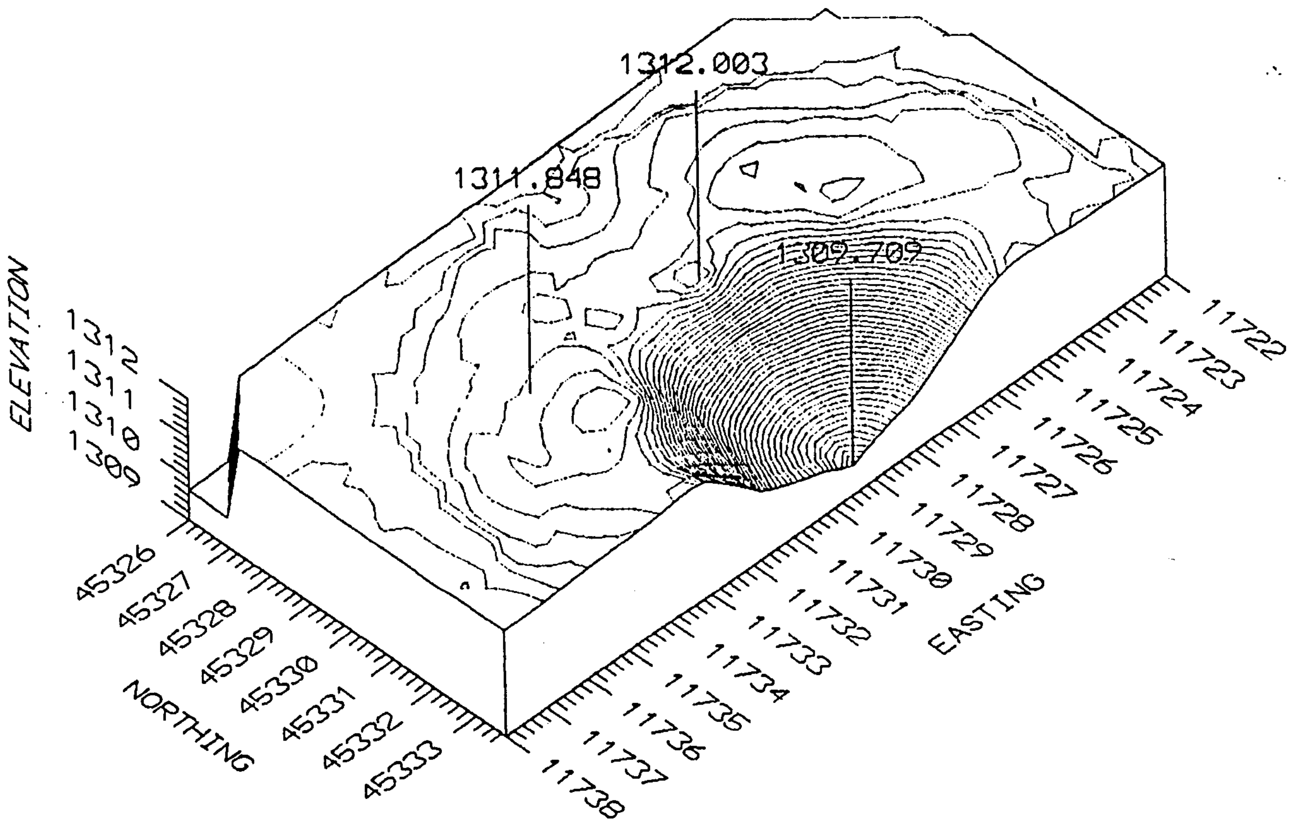
MAX. ELEVATIONS=1312.003
MIN. ELEVATIONS=1309.709
GRD. ELEVATIONS=1311.848

NOTE: ADD 4.400.000m TO ALL NORTHINGS. ADD 300.000m TO ALL EASTINGS.

OBOD DETONATION

SITE A-3

15 AUGUST 1990



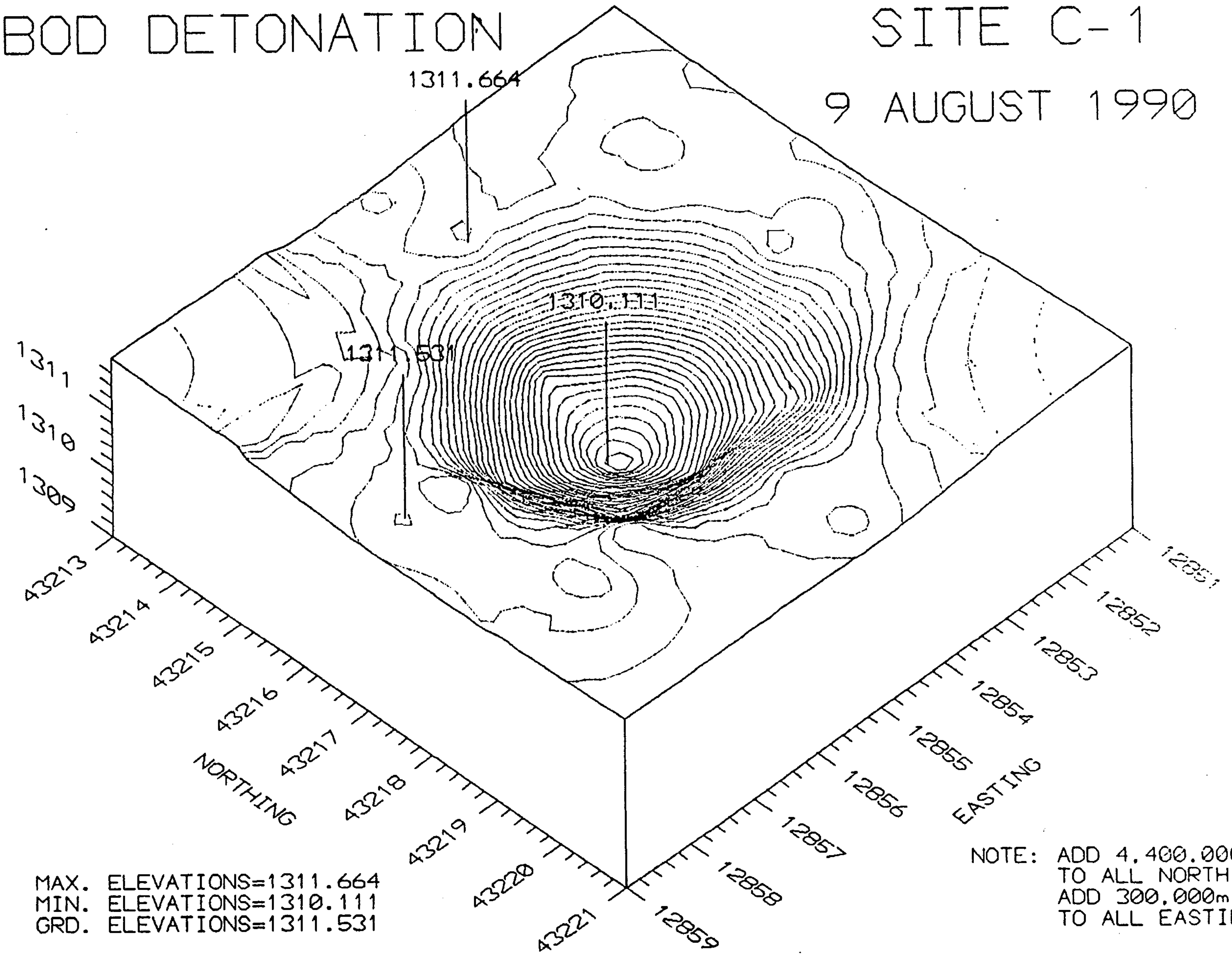
MAX. ELEVATIONS=1312.003
MIN. ELEVATIONS=1309.709
GRD. ELEVATIONS=1311.848

NOTE: ADD 4,400,000m TO ALL NORTHINGS.
ADD 300,000m TO ALL EASTINGS.

OBOD DETONATION

SITE C-1

9 AUGUST 1990



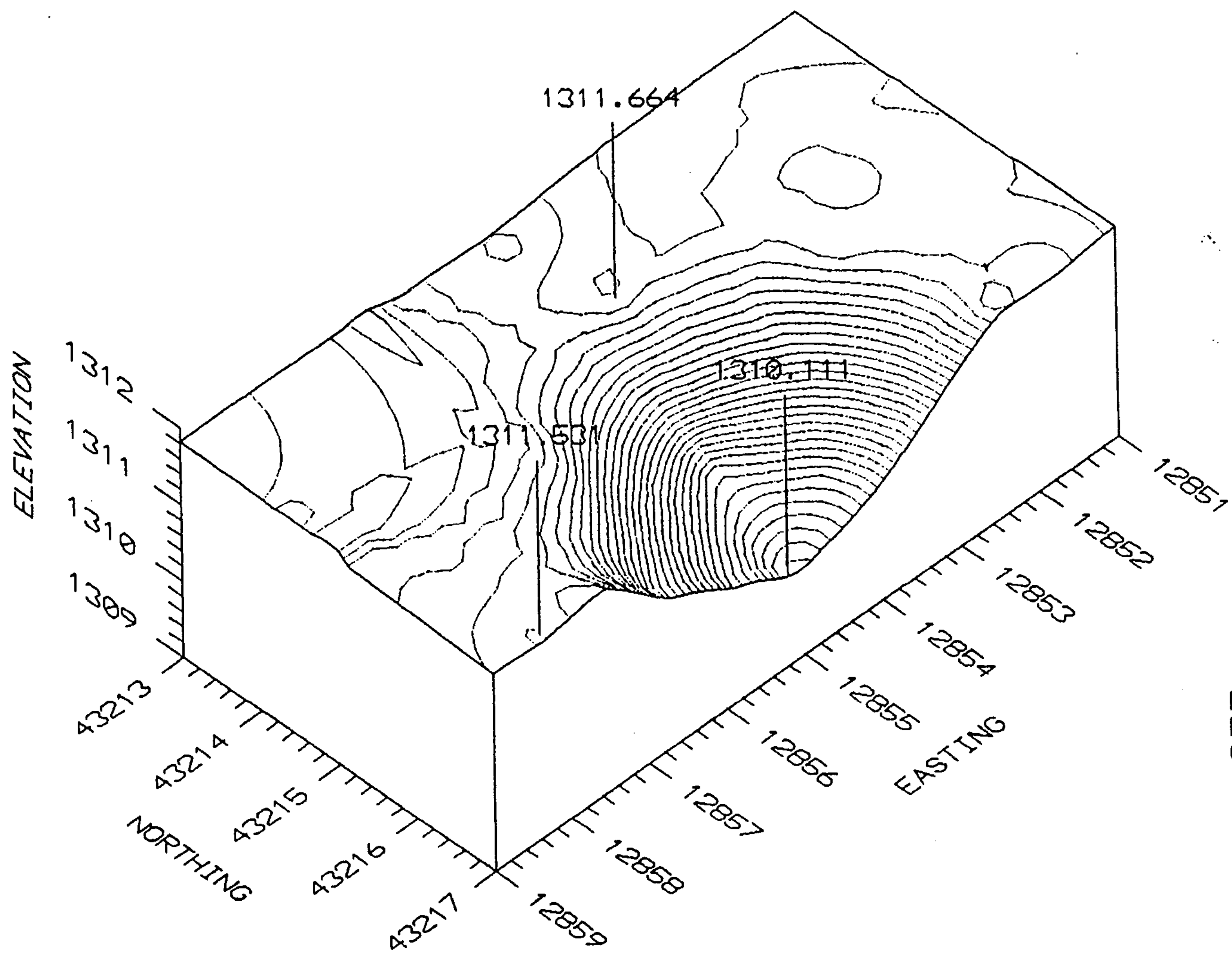
MAX. ELEVATIONS=1311.664
MIN. ELEVATIONS=1310.111
GRD. ELEVATIONS=1311.531

NOTE: ADD 4,400,000m TO ALL NORTHINGS. ADD 300,000m TO ALL EASTINGS.

OBOD DETONATION

SITE c-1

9 AUGUST 1990



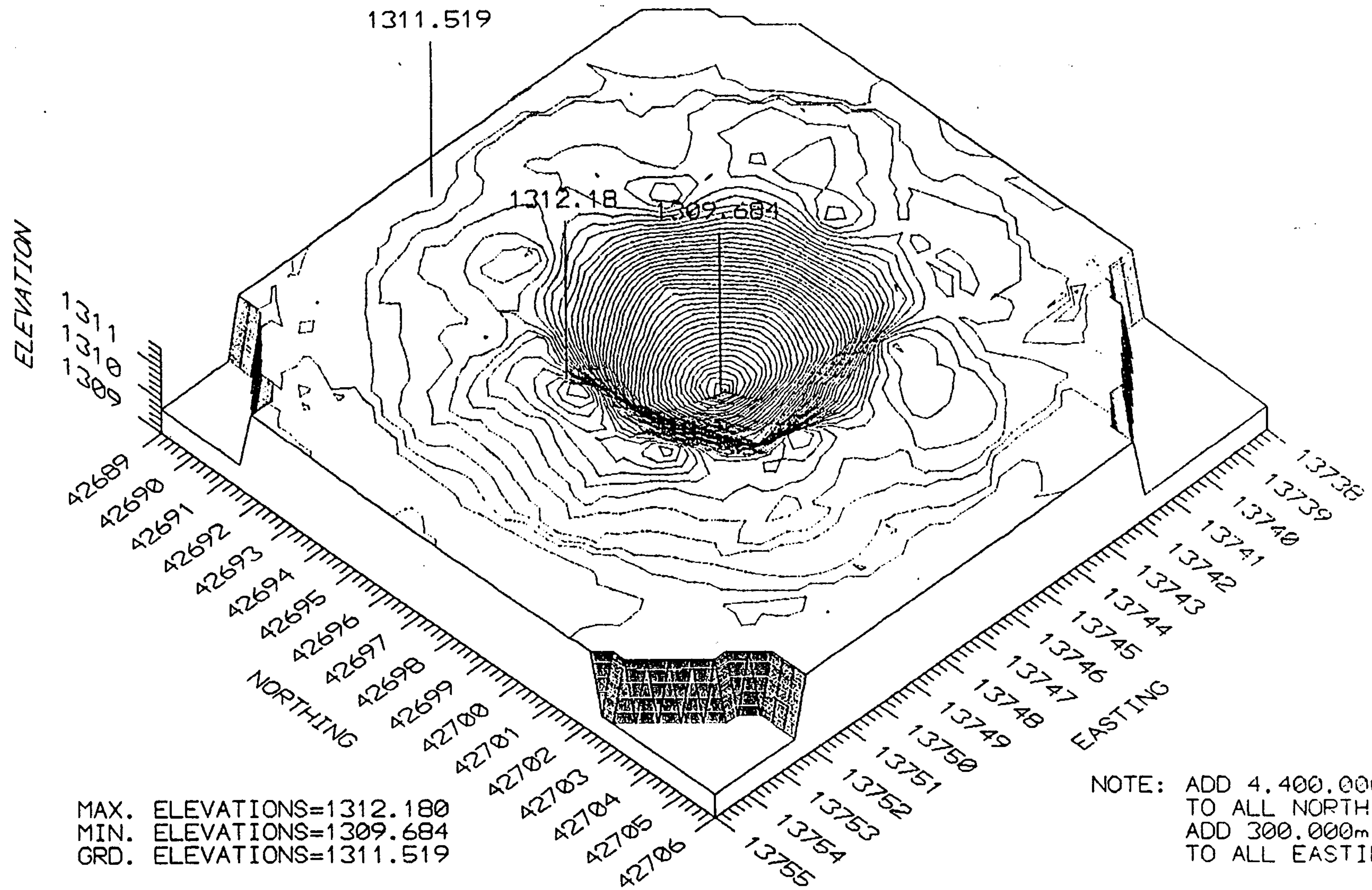
MAX. ELEVATIONS=1311.664
MIN. ELEVATIONS=1310.111
GRD. ELEVATIONS=1311.531

NOTE: ADD 4,400.000m TO ALL NORTHINGS.
ADD 300.000m TO ALL EASTINGS.

OBOD DETONATION

SITE C-3

9 AUGUST 1990



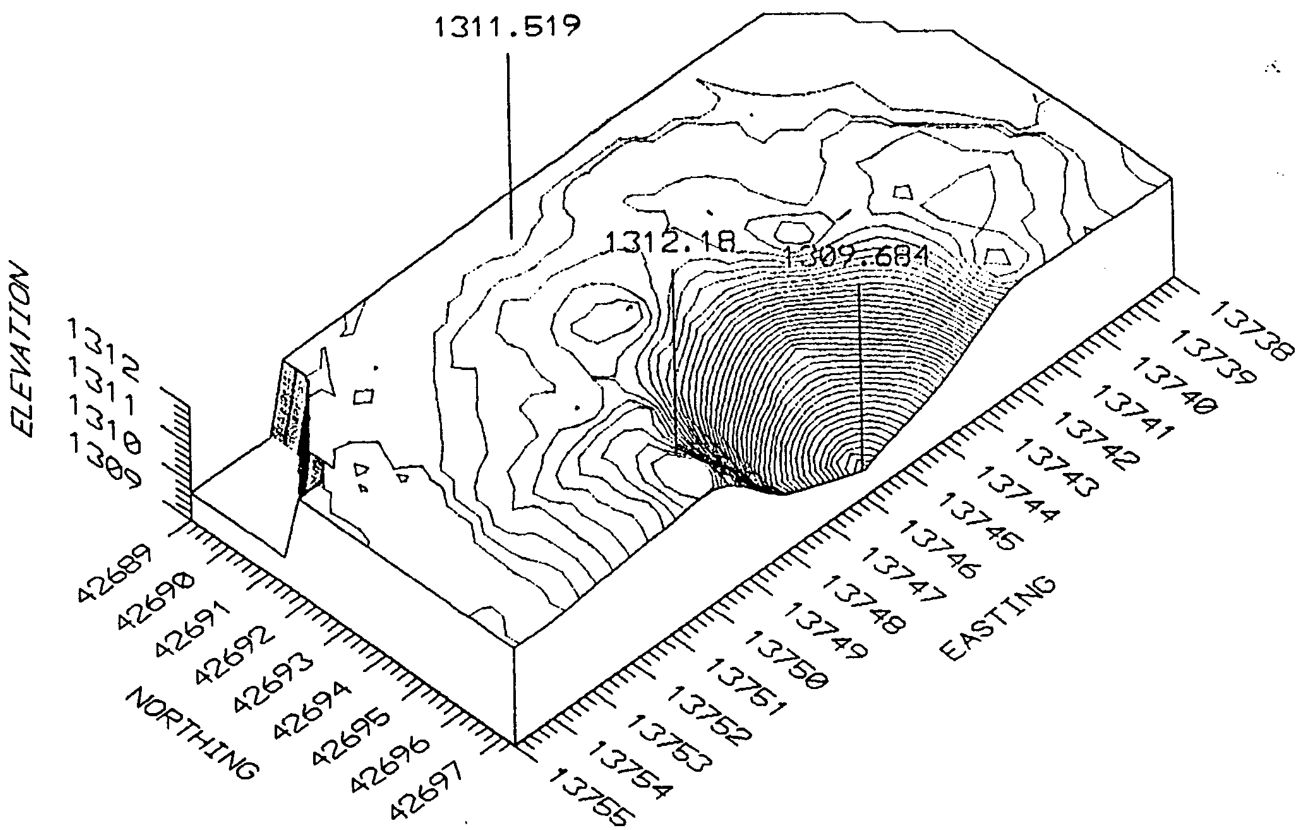
MAX. ELEVATIONS=1312.180
MIN. ELEVATIONS=1309.684
GRD. ELEVATIONS=1311.519

NOTE: ADD 4.400.000m TO ALL NORTHINGS. ADD 300.000m TO ALL EASTINGS.

OBOD DETONATION

SITE C-3

9 AUGUST 1990



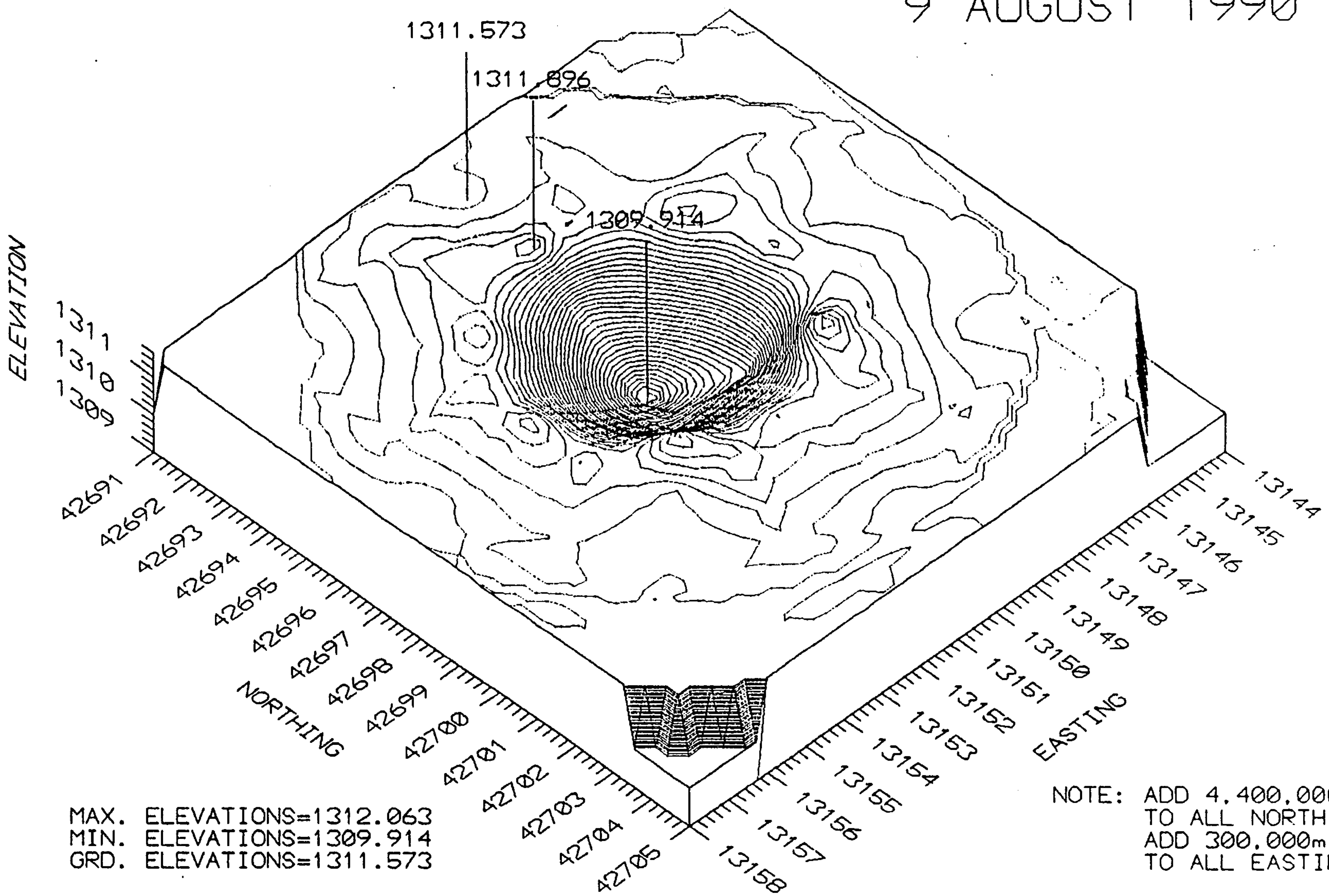
MAX. ELEVATIONS=1312.180
MIN. ELEVATIONS=1309.684
GRD. ELEVATIONS=1311.519

NOTE: ADD 4,400.000m
TO ALL NORTHINGS.
ADD 300.000m
TO ALL EASTINGS.

OBOD DETONATION

SITE C-ORI

9 AUGUST 1990



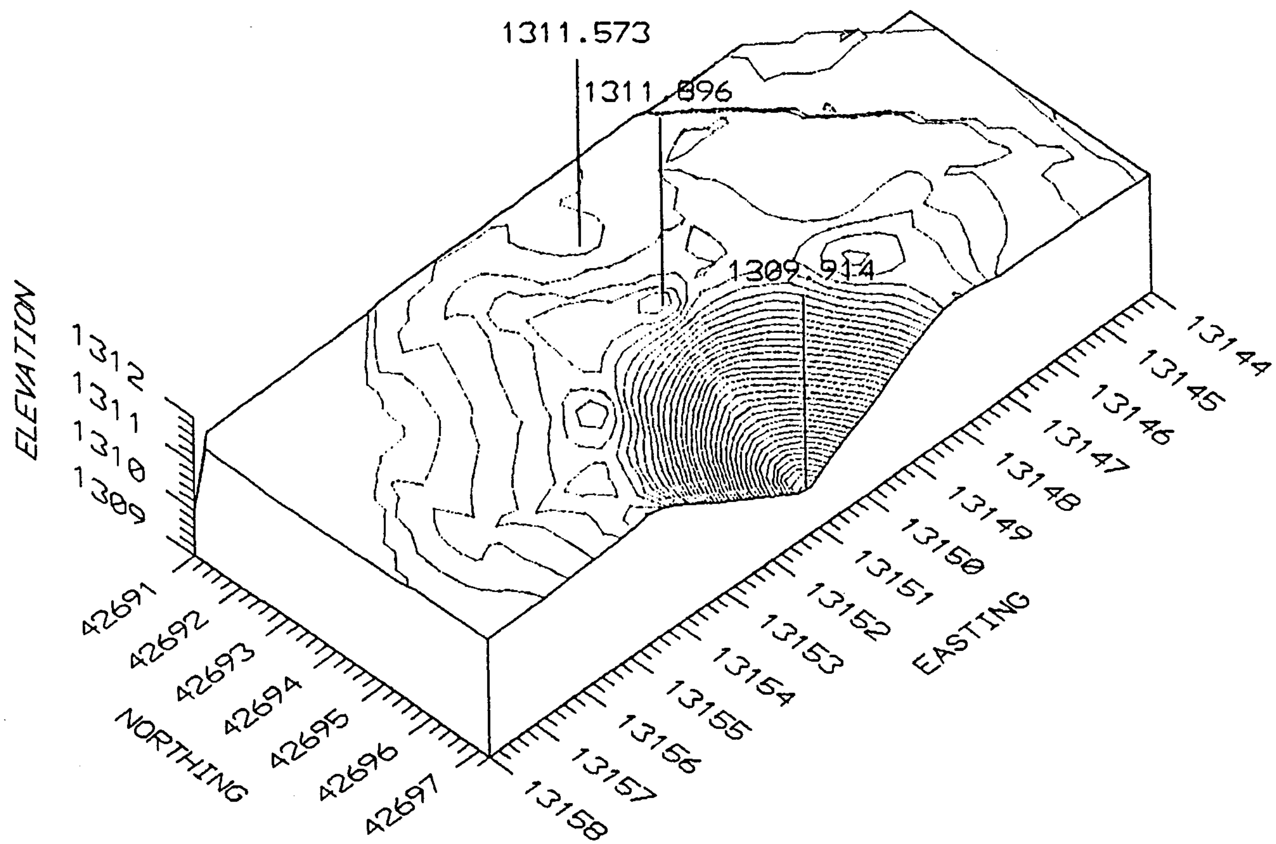
MAX. ELEVATIONS=1312.063
MIN. ELEVATIONS=1309.914
GRD. ELEVATIONS=1311.573

NOTE: ADD 4.400.000m TO ALL NORTHINGS.
ADD 300.000m TO ALL EASTINGS.

OBOD DETONATION

SITE C-ORI

9 AUGUST 1990



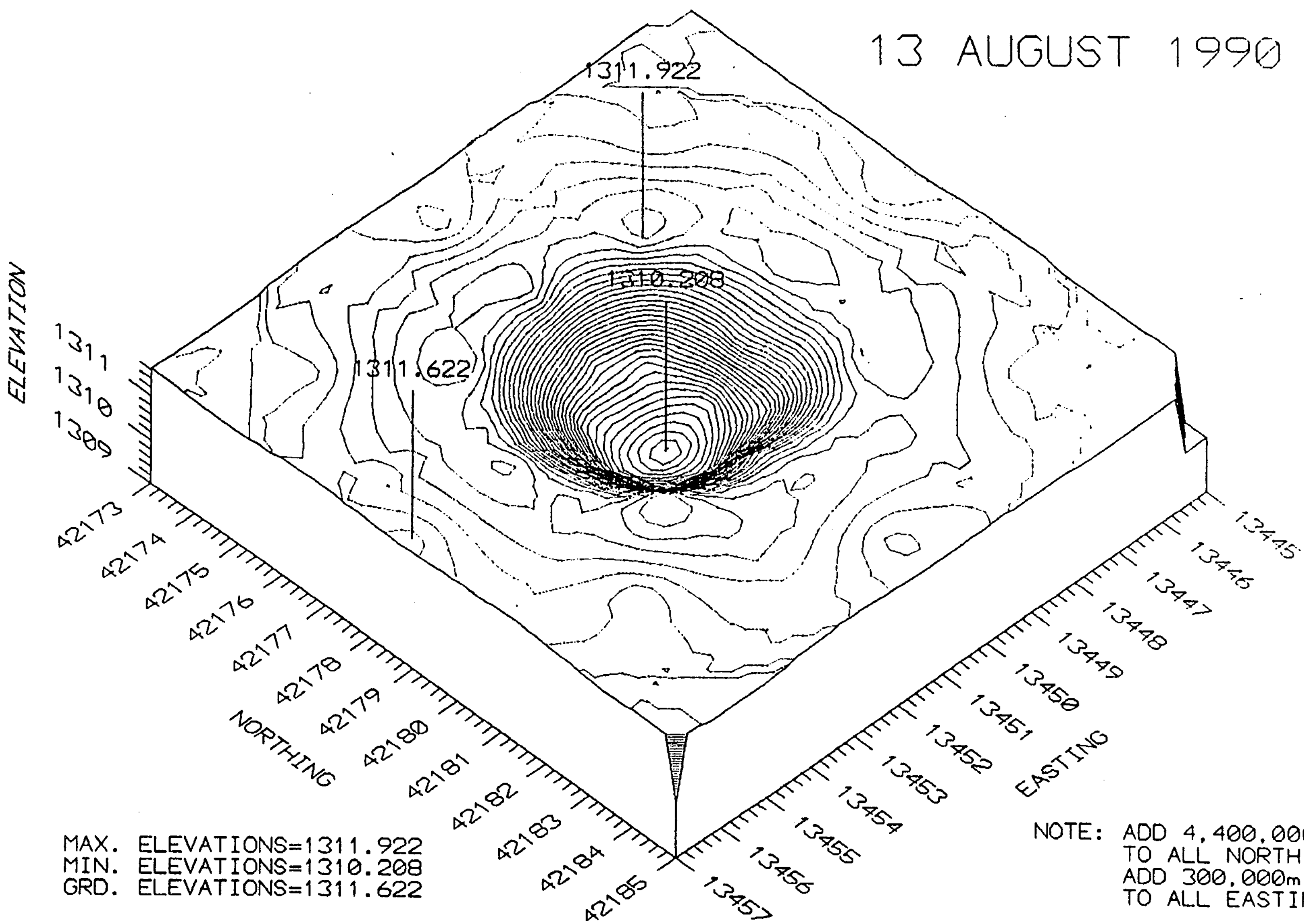
MAX. ELEVATIONS=1312.063
MIN. ELEVATIONS=1309.914
GRD. ELEVATIONS=1311.573

NOTE: ADD 4.400.000m TO ALL NORTHINGS.
ADD 300.000m TO ALL EASTINGS.

OBOD DETONATION

SITE C-4

13 AUGUST 1990

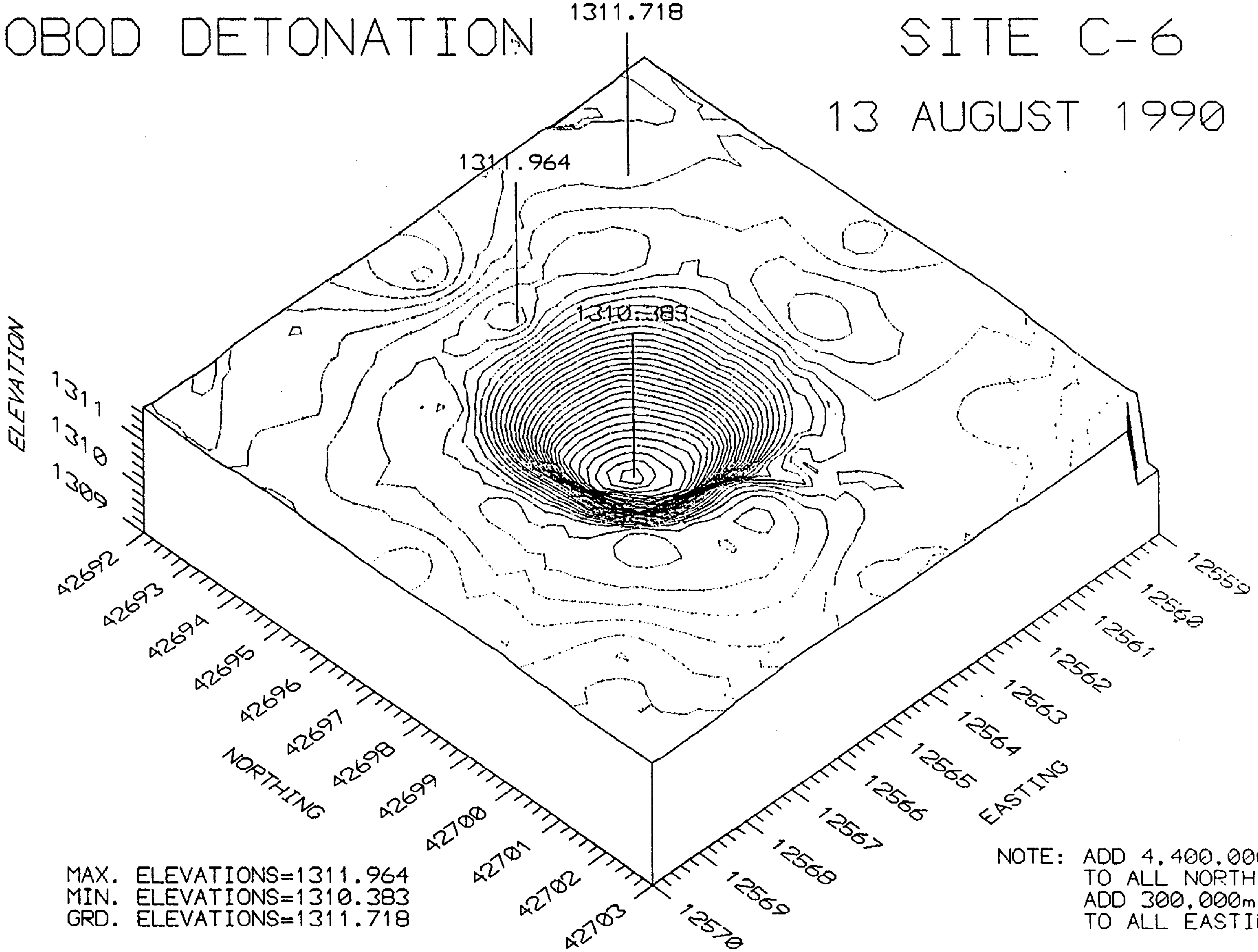


MAX. ELEVATIONS=1311.922
MIN. ELEVATIONS=1310.208
GRD. ELEVATIONS=1311.622

NOTE: ADD 4,400,000m TO ALL NORTHINGS. ADD 300,000m TO ALL EASTINGS.

OBOD DETONATION SITE C-6

13 AUGUST 1990



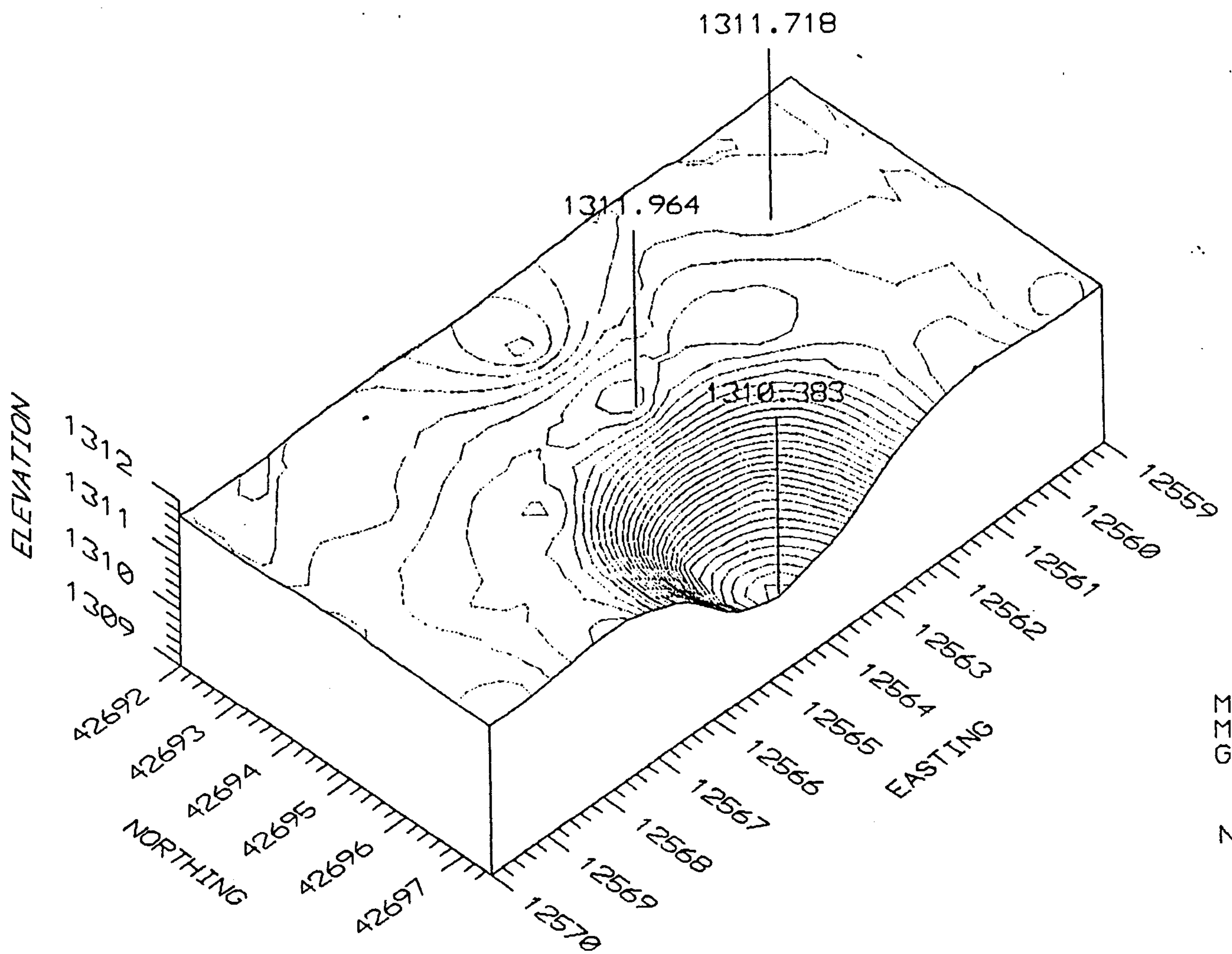
MAX. ELEVATIONS=1311.964
MIN. ELEVATIONS=1310.383
GRD. ELEVATIONS=1311.718

NOTE: ADD 4,400,000m TO ALL NORTHINGS. ADD 300,000m TO ALL EASTINGS.

OBOD DETONATION

SITE C-6

13 AUGUST 1990



MAX. ELEVATIONS=1311.964
MIN. ELEVATIONS=1310.383
GRD. ELEVATIONS=1311.718

NOTE: ADD 4,400,000m TO ALL NORTHINGS.
ADD 300,000m TO ALL EASTINGS.

APPENDIX D-4

SUMMARY OF OB/OD ENVIRONMENTAL PARTITIONING FACTORS

4.3 ENVIRONMENTAL PARTITIONING FACTORS

The Army OB/OD Tests (1988-1990) included field studies as well as bangbox emission tests. These field tests included sampling results from pans which measure deposition in the vicinity of OB/OD sources. The results from deposition samples provide insight regarding environmental transport partitioning factors (i.e., which portion of the OB/OD release or source term is airborne and what fraction goes to the soil).

The Army OB/OD Tests (1988-1990) indicated that most of the deposition of sputter ash (from the burn pan) and fallout ash (from the plume/cloud) occur within 12 m of the burn pan. Therefore for Subpart X permitting a soil contamination area of 12 m surrounding each burn pan can be used as an initial source area for input to a multimedia environmental transport model and for environmental sampling considerations.

A summary (range) of environmental transport partitioning factors based on the Army OB/OD field tests (1988-1990) approach to OB is presented in Table 4.3-1 for energetics and other semivolatiles. The soil is not considered a viable pathway for volatile organics or other gaseous emission products. Data for metals are not available. These results indicate a large variability for media-specific partitioning factors. However, the following conclusions are evident relevant to energetic/semivolatile emissions:

- The air pathway is the most significant <u>environmental transport</u> pathway.
- Potential soil contamination in the vicinity of the burn pans (within 12 m) represents only a small fraction of the total OB release to the environment.
- Pan residues (which are contained within burn pans and are not subject to environmental transport) in some cases represent a significant fraction of the emission products.

The compilation of average burn pan residue <u>emission factors</u> based on OB field tests shows a range of 2.7E-4 to 1.8E-3 and an average of 1.0E-3. These values provide an estimate of the quantity of ash generated from OB operations and associated ash storage and disposal needs (for planning purposes for an installation).

A summary (range) of environmental transport partitioning factors based on the Army OB/OD field tests (1988-1990) applicable to OD is presented in Table 4.3-2 for energetics and other semivolatile organics. (Data for metals are not available.) Most of these values indicate a variability within an order of magnitude (significantly less than for OB partitioning factors) and tests results support the following conclusions relevant to energetic and semivolatile emissions.

- The air pathway and soil pathway are significant OD source terms.
- Most (approximately 98 percent) of the initial soil contamination occurs in the vicinity of the OD crater due to ejecta. This area is of greatest concern as a source term input for multimedia environmental transport modeling as well as for environmental sampling purposes.

Table 4.3-1. Summary of Environmental Transport Partitioning Factors Based on Emission Test Data* —OB

Environmental Pathway	Range of Partitioning Factors** (Fraction of Total Emission for Contaminant Category)	
	Energetics	Semivolatile (Non-Energetics)
Air	2.1E-2 - <u>1.0E-0</u>	7.0E-1 - <u>1.0E0</u>
Soil (15-m radius)	4.2E-5 - <u>2.0E-2</u>	1.6E-7 - <u>1.4E-4</u>
Pan Residue	5.6E-6 - <u>9.8E-1</u>	8.3E-8 - <u>2.8E-1</u>

_____ = Highest value for each media and contaminant class combination.

* Army OB/OD Tests (1988-1990) data.

** Range of values from the compilation of an estimate of the average partitioning factor for each OD field test.

Table 4.3-2. Summary of Environmental Transport Partitioning Factors Based on Emission Test Data* —OD

Environmental Pathway	Range of Partitioning Factors** (Fraction of Total Emission for Contaminant Category): Energetics	Range of Partitioning Factors** (Fraction of Total Emission for Contaminant Category): Semivolatile (Non-Energetics)
Air	3.2E-2 - <u>1.0E0</u>	4.2E-1 - <u>1.0E0</u>
Soil: total	1.1E-1 - <u>9.7E-1</u>	2.0E-1 - <u>5.8E-1</u>
(Ejecta: crater)	(1.1E-1 - <u>8.9E-1</u>)	(1.9E-1 - <u>5.6E-1</u>)
(Fallout: 200-m radius)	(4.8E-3 - <u>2.5E-1</u>)	(7.3E-3 - <u>1.9E-2</u>)

_____ = Highest value for each medium and contaminant class combination.

* Army OB/OD tests (1988-1990) data.

** Range of values from the compilation of an estimate of the average partitioning factor for each OD field test.

- Soil contamination beyond the crater out to 200 m from the point of detonation typically represents only 2 percent of the release.
- Soil contamination from the OD release is considered insignificant beyond 200 m from the point of detonation.

The maximum air and soil partitioning factors presented in Tables 4.3-1 and 4.3-2 provide a conservative basis to postulate OB and OD source terms, respectively, for Subpart X permitting applications. These partitioning factors can also be used to apply bangbox air emission factors to the soil as well as to the air media.

HEADQUARTERS
U.S. ARMY ARMAMENT, MUNITIONS AND CHEMICAL COMMAND

FINAL REPORT

DEVELOPMENT OF METHODOLOGY AND TECHNOLOGY FOR IDENTIFYING AND QUANTIFYING EMISSION PRODUCTS FROM OPEN BURNING AND OPEN DETONATION THERMAL TREATMENT METHODS.

FIELD TEST SERIES A, B, AND C

VOLUME 1
TEST SUMMARY

JANUARY 1992

Maintenance Management Division
Demilitarization and Technology Branch
Rock Island, Illinois 61299-6000
DSN: 793-3980/5534
Commercial: 309-782-3980/5534

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION: UNCLASSIFIED

1b. RESTRICTIVE MARKINGS: None

2a. SECURITY CLASSIFICATION AUTHORITY: N/A

2b. DECLASSIFICATION / DOWNGRADING SCHEDULE: N/A

3. DISTRIBUTION / AVAILABILITY OF REPORT: Unlimited

4. PERFORMING ORGANIZATION REPORT NUMBER(S)

5. MONITORING ORGANIZATION REPORT NUMBER(S)

6a. NAME OF PERFORMING ORGANIZATION: Andrulis Research Corporation, Salt Lake City Office

6b. OFFICE SYMBOL (If applicable)

7a. NAME OF MONITORING ORGANIZATION: STEDP-MT-TM-A, Dugway Proving Ground

6c. ADDRESS (City, State, and ZIP Code): 4600 East-West Highway, Suite 900, Bethesda, MD 20814

7b. ADDRESS (City, State, and ZIP Code): Dugway, Utah 84022-5000

8a. NAME OF FUNDING / SPONSORING ORGANIZATION: U.S. Army Armament, Munitions and Chemical Command

8b. OFFICE SYMBOL (If applicable): AMSMC-DSM-D

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: Contract DAAD09-87-D-0008

8c. ADDRESS (City, State, and ZIP Code): Maintenance Management Division, Demilitarization and Technology Branch, Rock Island, Illinois 61299-6000

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification): Development of Methodology and Technology for Identifying and Quantifying Emission Products from Open Burning and Open Detonation Thermal Treatment Methods. Field Test Series A, B, and C - Volume 1.

12. PERSONAL AUTHOR(S): Mr. MacDonald Johnson

13a. TYPE OF REPORT: Final Report

13b. TIME COVERED: FROM 12-88 TO 1-92

14. DATE OF REPORT (Year, Month, Day): 92 January

15. PAGE COUNT

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number): open burning; open detonation; OB/OD; TNT; double base propellant; manufacturers residue propellant; air emissions; thermal treatment; carbon balance; emission factor; (Cont'd on reverse)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The report covers the OB/OD field tests A, B, and C using the methodology and technology developed in the BangBox (BB) test for use on the fixed-wing aircraft (FWAC). Field test A was a checkout of the equipment and sampling selected from the BB test, and the development of procedures for sampling the TNT detonation crater soil, and the particle fallout in the surrounding area. Triple-base propellant was also burned in pans with the area sampled to 30-m with fallout pans. The analytes in both the air emission and the soil were identified and quantified. Field test B used TNT as the explosive and manufacturing residue as the burn material. Air sampling with the FWAC and soil sampling provided estimates of emission factors (EF) and soil contaminates that were detected above background levels. Suspended TNT detonations and manufacturing residue burns were also characterized for emission products. Phase C test using refinements in sampling and analysis from the previous phases provided data for TNT, composition B, explosive D, and RDX detonations and manufacturing residue single-base (M1,M6) propellant burns. The EF data from the TNT field tests were examined and compared with BB data; the results were comparable in the analytes detected and the level of analytes detected. The results indicate an efficiency for the detonation >92 percent (Continued on reverse)

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT: ☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION: UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL: Mr. MacDonald Johnson

22b. TELEPHONE (Include Area Code): (309) 782-3980/5534

22c. OFFICE SYMBOL: AMSMC-DSM-D

DD Form 1473, JUN 86 — Previous editions are obsolete. — SECURITY CLASSIFICATION OF THIS PAGE

SECTION 6. CONCLUSIONS

6.1. Background

6.1.1. BangBox

The BB conclusions are stated in the BB report, Volume 1.

6.1.2. Field Test Phase A

6.1.2.1. Purpose

Field Test Phase A was designed as a program ORI.

6.1.2.2. Objectives

6.1.2.2.1 Objec·ve 1 - Evaluate the performance of the instrumented FWAC as a sampling platform during large-scale field OB/OD tests.

a. The FWAC proved to be a suitable sampling platform. The aircraft's design enabled the aircraft to enter and sample the plume within approximately 1 min after the detonation, and make repeated penetrations of the plume. The sampling passes made through the cloud permitted real-time analyses of some gases and captured sufficient quantities of gases and particulates for subsequent analyses.

b. Additionally the instruments and procedures used on the FWAC were judged suitable for subsequent testing.

6.1.2.2.2 Objective 2 - Determine if target species can be adequately sampled and measured above background levels.

a. Carbon dioxide and other target species were adequately sampled and measured above background levels using real-time instruments aboard the FWAC.

b. The VOC's were successfully measured above background levels with the 6-L canister sampler. Carbon dioxide and CO were also successfully measured above background with the 6-L canister.

c. The quartz fiber filters collected sufficient particulate for the detection and quantification. of SVOC's.

6.1.2.2.3 Objective 3 - Evaluate the utility of the carbon balance method in the field testing environment.

The utility of the carbon balance method was confirmed. The FWAC ability to enter the plume and measure CO_2 well above background supports the carbon balance method applicability to field testing.

6.1.2.2.4 Objective 4 - Evaluate soil sampling, handling, and assay procedures (e.g. SFC/MS) for field OB/OD tests.

Soil sampling, handling, and assay procedures were proven suitable for capturing and analyzing emittant products released into the soil during field testing.

6.1.3. Field Test Phase B

6.1.3.1. Purpose

Confirm suitability of instruments and procedures developed in Phase A, and determine if relationship exists between BB test data and field test data.

6.1.3.2. Objectives

6.1.3.2.1 Objective 1 - Sample and analyze the combustion products of large-scale OB/OD operations which were conducted in a manner representing treatment site practices.

The combustion products of large-scale OB/OD operations were successfully sampled and analyzed. However, the test could not accommodate evaluation of emission product accumulation at a single site resulting from repeated detonations.

6.1.3.2.2 Objective 2 - Sample and analyze the combustion products produced by large-scale OB/OD operations which were conducted from suspended detonations.

Large-scale OD suspended detonations were successfully conducted, and the resulting clouds sampled and analyzed. While emission products were essentially the same as for non-suspended surface detonations, a more efficient conversion of the explosive carbon into CO_2 and decreased levels of the other carbon compounds were detected.

6.1.3.2.3 Objective 3 - Determine if the field test detonation data can be related to the BB test detonation data.

The initial comparison between the BB and field test data reveals that a relationship between BB and field test data can be established. The pattern that emerges is: (1) small-scale detonations in the BB test produced a more efficient conversion of TNT carbon to CO_2 than did large-scale detonations in the field; (2) the VOC levels experienced during large-scale field testing were higher than those experienced during BB testing; and (3) the semivolatile organic compounds detected and quantified were very similar.

6.1.3.2.4 Objective 4 - Provide the foundation for establishing a database on TNT and selected propellant combustion products.

The initial combustion product database for bulk TNT and selected propellant manufacturing residues was established. A list of analytes and their concentration per mass for air emissions, soil, and residue has been established.

6.1.4. Field Test Phase C

6.1.4.1. Purpose

Supplement the basic TNT and propellant data, and expand the database to include additional explosives and propellants.

6.1.4.2. Objectives

6.1.4.2.1 Objective 1 - Conduct additional TNT detonations to facilitate relating BB test results to field test results.

The additional successful TNT OD conducted during phase C added to the database of air EF's from field test phases A and B. The conclusions are discussed in paragraph 6.1.4.2.3.

6.1.4.2.2 Objective 2 - Conduct additional TNT tests to establish the reproducibility (between test precision) of TNT OD emissions.

The surface TNT tests phases A, B, and C were very reproducible, e.g., EF's for CO_2 varied from 1.26 to 1.29, CO varied from 42×10^{-3} to 61×10^{-3}, and methane varied from 1.2×10^{-3} to 1.5×10^{-3}. Section 4 contains specific results for all the compounds targeted in the OB/OD testing.

6.1.4.2.3 Objectives 3-7 - Sample and analyze the explosive and burning decomposition products of composition B, explosive D, RDX, M1 and M6 propellants, and additional propellant manufacturing residues.

a. The explosives tested during phase C produced results (emissions and levels) very similar to those results obtained for TNT tested in phases A and B. The small-scale BB test showed more efficient conversion of TNT carbon to CO_2 than found during field testing; (2) the VOC levels increased in the large-scale field test, and the semivolatile organic compounds detected and quantified during all tests were very similar.

b. The soil data from phases B and C were very similar (overlapping ranges of the concentration values), therefore all the analysis were performed on the total data package of phases B and C. Phase A was not considered because it was an ORI.

c. The propellant data was very efficient in conversion of carbon to CO_2, however the residue in the pan after burning was tested and showed the presence of 2,4-DNT, which is one of the parent compounds in the M1 and M6 propellants.

d. This phase of the study did not include analysis for metals and non-metals (elementals).

6.2. General Overall Test Program

6.2.1. Purpose

Supply waste characterization data for OB/OD permit applications under RCRA subpart X.

6.2.2. Objectives and Responses

6.2.2.1. Objective 1 - Identify and validate sampling and analytical technology, instrumentation, and procedures needed to provide RCRA subpart X data characterization.

6.2.2.1.1 The results of this phase of the OB/OD thermal-treatment emission study authenticate the innovative technologies and methodologies selected for identifying and characterizing emission products.

6.2.2.1.2 The comparable TNT data from the BB and field tests indicates that the time and costs of characterizing emissions from specific PEP materials in the inventory can be significantly reduced by using properly designed BangBox-like chambers.

6.2.2.1.3 If the comparable results, established during this test remains consistent during further BB testing, the techniques and methods developed will assist in the identification of PEP materials for which OB/OD thermal treatment methods is not applicable and for which alternative

technologies must be developed. With this knowledge, the development of alternative technologies can be focused and more cost-effective.

6.2.2.2. Objective 2 - Identify and quantify emissions and residues produced by OB/OD thermal treatment methods.

6.2.2.2.1 Identification and quantification of emission products and residues produced by OB/OD methods was accomplished for those items tested and the amount of pollutants released into the atmosphere and soil were considered inconsequential. This data was used to authenticate methodology and technology used during this phase of the study.

6.2.2.2.2 This objective will be completed during the next phase of the overall program when item- and site-specific testing will be undertaken.

6.2.2.3. Objective 3 - Provide input for development and validation of an OB/OD dispersion model.

6.2.2.3.1 An OB/OD dispersion model was developed during this phase of the study. The model will require field validation before being made available.

6.2.2.3.2 A dispersion model acceptable to EPA is an essential adjunct to the BB emission characterization data in that it provides the mechanism to generate the downwind concentration receptor locations as inputs required for support of site-specific permit applications.

6.2.2.3.3 The data obtained from sample analysis, as applied to the DPG-RTVSM model, indicates exceptionally low downwind peak and average concentrations for all pollutant categories following downwind dispersion of the detonation cloud.

6.2.2.4. Objective 4 - Identify specific items that can be treated by OB/OD thermal treatment methods without adverse environmental impact.

6.2.2.4.1 The study suggests that the bulk explosives and propellants examined during field testing will produce and release acceptable levels of emittants to the environment by surface OB/OD methods. While these results are encouraging, site-specific testing is needed to provide data to support risk assessments. Only after these risk assessments are completed may a definitive statement be made concerning the effect (if any) OB/OD operations have on human health and the environment.

6.2.2.4.2 For many items, OB/OD thermal treatment operations may be an environmentally safe means of treatment, in addition to being cost-effective. If this proves true, OB/OD should be considered for use as an integral part of a balanced DoD total demilitarization/treatment program.

6.3. Air Emissions

6.3.1. Detonation/Combustion Efficiency

A high degree of carbon conversion to CO_2 occurred for all types of PEP materials examined in this test series.

6.3.1.1. Propellants

All tested propellants consistently showed carbon conversion efficiencies exceeding 99 percent.

This is primarily a result of two factors: (1) The oxygen balance of most of the propellant materials tested was relatively high, and the propellant molecule carried most of the oxygen required for complete combustion; (2) Propellant materials were in steel pans eliminating interaction with adjacent soil. The absence of soil in the flame zone resulted in high flame temperatures and facilitated complete combustion of carbon.

6.3.1.2. Explosives

Carbon conversion efficiencies for the bulk explosive materials tested were lower than those observed for propellants, but were still in excess of 92 percent for all explosive types and configurations tested.

6.3.1.2.1 This observation applies to TNT which has a very low (-73.9 percent) oxygen balance and represents a worst case explosive from the perspective of pollutant emissions.

6.3.1.2.2 The carbon conversion efficiencies in excess of 92 percent found for low oxygen-balance surface-detonated TNT reveals that a mechanism of secondary combustion is in effect during these detonations.

a. Entrainment of ambient oxygen into the fireball region following detonation of the explosive accounts for this secondary combustion of intermediate detonation products to CO_2.

b. Suspended detonations of TNT (for which soils is a relative unimportant consideration) produced higher carbon conversion efficiencies. This suggest the presence of soil in the immediate vicinity of the detonation (typical of surface detonations), restricts the flow of ambient air into the fireball region.

6.3.1.2.3 The carbon conversion efficiencies for other bulk-explosive types examined in this series (i.e., RDX, explosive D, composition B) show that carbon conversion efficiencies are approximately the same as for TNT, even though all of the explosives tested have higher oxygen balances than TNT.

6.3.1.2.4 The data indicates that while the oxygen balance of the explosive molecule is important, it is not the only parameter determining the degree of efficiency of the detonation.

6.3.1.2.5 All explosives have the capability to produce high-carbon-efficiency detonations if sufficient ambient oxygen is entrained following formation of the fireball.

6.3.1.2.6 The configuration of the detonation (surface vs. suspended) appears also to be an important parameter in determination of the carbon conversion efficiency.

6.3.2. Carbon Distribution

6.3.2.1. Carbon not converted to CO_2 is found in other species produced by the combustion such as carbon monoxide, methane, nonmethane hydrocarbons, organic carbon particulate and elemental carbon particulate.

6.3.2.2. In general, each of these categories, with the exception of CO_2 and CO, receives between 0.1 and 1 percent of the total original carbon.

6.3.2.3. The amount of CO formed ranged from 0.5 percent for suspended detonations to 5 percent for surface detonations.

6.3.2.4. Distribution of carbon within the nonmethane hydrocarbon category reveals a relatively high distribution of the carbon to the light, non toxic, nonmethane hydrocarbons, such as ethane, propane, acetylene, etc.

6.3.2.4.1 There is little experimental evidence to suggest that any significant portion of the source carbon goes to the heavier aromatic volatiles, such as benzene and toluene.

6.3.2.5. The elemental carbon (soot) and the organic particulate carbon categories each typically receive on the order of 0.1 to 1 percent of the carbon.

6.3.2.5.1 The amount of particulate organic carbon from soil debris in the cloud and that produced by the detonations could not be separated.

6.3.2.6. Analysis of the particulate organic material collected in these detonation and propellant cloud samples reveals that a considerable fraction is due to the environmentally ubiquitous phthalates, which were also found in the background samples.

6.3.3. Scaling Issues

6.3.3.1. The degree to which the size of the detonation affects relative distribution of pollutants released from the detonation is an important part of this study.

6.3.3.1.1 A comparison of emission factors for the various pollutant species examined in the BangBox and in the field tests shows that emission factors for potentially toxic emissions are relatively constant, despite a near 4,000-fold increase in the scale of the detonation.

6.3.3.1.2 Light gases such as CO and methane show the greatest variation in EF with changes in size of the detonation.

6.3.3.1.3 The other pollutant categories such as NO_x, VOC, and semivolatile categories show less pronounced changes in EF with changes in size of the detonation.

6.3.3.2. These results strongly indicate that BB-type testing can be successfully used to assess pollutant emissions from various explosive types and configurations.

6.3.3.3. Use of such testing will significantly reduce both the time and costs required for emission characterization of PEP materials in the DoD inventory.

6.3.4. Source Pollutant Dispersion Modeling

6.3.4.1. Results of the DPG real-time volume source dispersion model (RTVSM) for estimating ground-level concentrations of analytes from a 1-metric-ton (1000-kg) surface detonation show exceptionally low downwind peak and average concentrations for all pollutant categories following downwind dispersion of the detonation cloud.

6.3.4.2. Surface-detonation TNT events which were conducted to obtain typical EF such as CO (EF = 5×10^{-2}), benzene (EF = 1×10^{-4}) and benzo[a]pyrene (EF = 0.1×10^{-6}) reveal that ground level peak and 15-min average concentrations would be indistinguishable from background levels of these various pollutants.

6.4. Soil Deposition of OB/OD Emissions

6.4.1. OD Emissions

6.4.1.1. Total amounts of emission products for semivolatile organics can also be quantified from the mass of disturbed soil (estimated from the crater dimensions) and the concentration of analytes in the soil. For example, this method shows that 3.7 g of 2,4-dinitrotoluene will be produced and released to the soil following a 907-kg TNT detonation.

6.4.1.2. Emission products of semivolatile organics can be identified and quantified from the fallout soil at specific distances from the explosive source. This method shows that 76 mg (2 percent) of the total 3.7 g of 2,4-dinitrotoluene produced was recovered within 225 m of the detonation site.

6.4.1.3. The major portion of all the semivolatile organic particulate remains in the loose soil of the crater and ejecta area (the immediate vicinity of the crater). The loose soil is subjectively estimated to account for about 97 to 98 percent of all the semivolatiles produced.

6.4.2. OB Emissions

6.4.2.1. Open burning is very effective in volatilizing and burning the parent material. The small quantities of residue left are largely composed of char or elemental carbon.

6.4.2.2. The OB of M1 and M6 propellant resulted in a residue fraction of approximately 0.1 percent of the original mass of propellant. The 2,4-dinitrotoluene, which makes up 10 percent of the parent propellant, is reduced to 0.0025 and 0.013 percent of the residue for M1 and M6 respectively. An even greater reduction occurs in the fallout material, where the maximum 2,4-dinitrotoluene amount was 0.00009 and 0.0004 percent for M1 and M6 propellant respectively, indicating that carbon conversion is still occurring in the plume from the burning propellant.

6.4.2.3. Residue in the burn pan following the Phase C manufacturing residue burn was approximately 0.03 percent of the original mass. Using the maximum measured 2,4-dinitrotoluene

concentration of 24 ng/m^2 as representative of the terrain deposition from a 2-metric ton burn, results in a total deposition of 0.024 mg of 2,4-dinitrotoluene spread over 1000 m^2.

6.4.2.4. The OB of M30 triple base propellant burned during Phase A trials was composed of 28.0 percent nitrocellulose, 22.5 percent nitroglycerin, and 47.7 percent nitroguanidine, respectively, by weight of the parent propellant. After burning, nitroglycerin and nitroguanidine were detected and represents 0.00007 and 0.00008 percent of the residue respectively. These low residue fractions show near complete combustion of the propellant.

APPENDIX E

SECTION 5.0 SUPPORT MATERIAL

- E-1 Example Information from ORNL Health and Environmental Data Base
- E-2 Available Environmental Criteria

APPENDIX E-1

EXAMPLE INFORMATION FROM ORNL HEALTH AND ENVIRONMENTAL DATA BASE

NOTE:

ORNL Database Does Not Include Complete National Ambient Air Quality Standards (NAAQS) Information

HEALTH AND ENVIRONMENTAL STANDARDS AND ADVISORY CRITERIA

Prepared for:

Hazardous Waste Remedial Action Program

Prepared by:

Chemical Hazard Evaluation Group
Biomedical and Environmental Information Analysis Section
Health Sciences Research Division
Oak Ridge National Laboratory

April 1995

CHEMICALS LISTED IN ALPHABETICAL ORDER

CHEMICALS LISTED IN ALPHABETICAL ORDER

Chemical	CAS Number
ANTU	000086-88-4
Acetaldehyde	000075-07-0
Acetamide	000060-35-5
Acetone Cyanohydrin	000075-86-5
Acetone Thiosemicarbazide	001752-30-3
Acetonitrile	000075-05-8
Acetophenone	000098-86-2
Acetylaminofluorene, 2-	000053-96-3
Acetylene	000074-86-2
Acrolein	000107-02-8
Acrylamide	000079-06-1
Acrylic Acid	000079-10-7
Acrylonitrile	000107-13-1
Acrylyl Chloride	000814-68-6
Adiponitrile	000111-69-3
Aldicarb	000116-06-3
Aldrin	000309-00-2
Allyl Alcohol	000107-18-6
Allyl Chloride	000107-05-1
Allylamine	000107-11-9
Aluminum	007429-90-5
Aluminum (alkyls)	
Aluminum (metal dust, respirable fraction)	007429-90-5
Aluminum (pyro powders)	
Aluminum (soluble salts)	
Aluminum (welding fume)	007429-90-5
Aluminum Phosphide	020859-73-8
Aminobiphenyl, 4-	000092-67-1
Aminopterin	000054-62-6
Amiton	000078-53-5
Amiton Oxalate	003734-97-2
Ammonia	007664-41-7
Ammonium Nitrate	006484-52-2
Ammonium Picrate	000131-74-8
Amosite	012172-73-5
Amphetamine	000300-62-9
Aniline	000062-53-3
Aniline, 2,4,6-Trimethyl-	000088-05-1
Anisidine, o-	000090-04-0
Anthracene	000120-12-7
Antimony	007440-36-0
Antimony Compounds (as Sb)	
Antimony Pentafluoride	007783-70-2
Antimycin A	001397-94-0
Arsenic	007440-38-2
Arsenic (Inorganic compounds)	
Arsenic (Organic compounds)	
Arsenic Pentoxide	001303-28-2
Arsenous Oxide	001327-53-3
Arsenous Trichloride	007784-34-1
Arsine	007784-42-1
Asbestos	001332-21-4
Azinphos-Ethyl	002642-71-9
Azinphos-Methyl	000086-50-0
Barium	007440-39-3
Barium (Soluble compounds)	
Barium Nitrate	010022-31-8
Benzal Chloride	000098-87-3
Benzenamine, 3-(Trifluoromethyl)	000098-16-8
Benzene	000071-43-2
Benzene, 1-(Chloromethyl)-4-nitro-	000100-14-1
Benzenearsonic Acid	000098-05-5
Benzidine	000092-87-5
Benzimidazole, 4,5-Dichloro-2-(trifluoromethyl)	003615-21-2
Benzo(a)anthracene	000056-55-3
Benzo(a)pyrene (also see Coal Tar Pitch Volatiles)	000050-32-8
Benzo(b)fluoranthene	000205-99-2
Benzo(c)acridine	
Benzo(k)fluoranthene	000207-08-9
Benzotrichloride	000098-07-7
Benzyl Alcohol	000100-51-6
Benzyl Chloride	000100-44-7
Benzyl Cyanide	000140-29-4
Beryllium	007440-41-7
Beryllium Compounds (as Be)	
Bicyclo [2.2.1] Heptane-2-carbonitrile, 5-chlor-6-((((methylamino)carbonyl) oxy)imino)-(1	015271-41-7
Biphenyl (diphenyl)	000092-52-4
Bitoscanate	004044-65-9
Boric Acid	010043-35-3
Boron	007440-42-8
Boron Trichloride	010294-34-5
Boron Trifluoride	007637-07-2
Boron Trifluoride Compound with Methyl Ether (1:1)	000353-42-4
Bromadiolone	028772-56-7
Bromine	007726-95-6
Bromoform	000075-25-2
Butadiene, 1,3-	000106-99-0
Butane, i-	
Butane, n-	000106-97-8
Butene, 1-	000106-98-9
Butene, cis-2-	000590-18-1
Butene, i-	
Butene, trans-2-	000624-64-6
Butyl benzyl phthalate	000085-68-7
Butylbenzene, sec-	000135-98-8
Butylphenol, 2,2-Methylene bis(4-methyl) 6-t-butylphen-	
Cadmium	007440-43-9
Cadmium (dust)	007440-43-9
Cadmium (dusts and salts)	
Cadmium (fume)	007440-43-9
Cadmium Compounds (as Cd)	
Cadmium Oxide	001306-19-0
Cadmium Stearate	002223-93-0
Calcium	007440-70-2
Calcium Arsenate	007778-44-1
Calcium Cyanamide	000156-62-7
Calcium Stearate	001592-23-0
Camphechlor	008001-35-2
Cantharidin	000056-25-7
Caprolactam (dust)	000105-60-2
Captan	000133-06-2
Carbachol Chloride	000051-83-2
Carbamic Acid, Methyl, O-(((2,4-dimethyl-1, 3-dithiolan-2-yl) methylene)amino)-	026419-73-8
Carbaryl	000063-25-2
Carbofuran	001563-66-2
Carbon Disulfide	000075-15-0
Carbon Monoxide	000630-08-0
Carbon Tetrachloride	000056-23-5
Carbonyl Sulfide	000463-58-1
Carbophenothion	000786-19-6
Carene, delta-3-	020296-50-8
Catechol	000120-80-9
Chloracetic Acid	000079-11-8
Chloramben	000133-90-4

CHEMICALS LISTED IN ALPHABETICAL ORDER

Chemical	CAS Number
Chlordane	000057-74-9
Chlorfenvinfos	000470-90-6
Chlorine	007782-50-5
Chlormephos	024934-91-6
Chlormequat Chloride	000999-81-5
Chloroacetophenone, 2-	000532-27-4
Chlorobenzene	000108-90-7
Chlorobenzilate	000510-15-6
Chloroethanol	000107-07-3
Chloroethyl Chloroformate	000627-11-2
Chloroform	000067-66-3
Chloromethyl Ether	000542-88-1
Chloromethyl Methyl Ether	000107-30-2
Chlorophacinone	003691-35-8
Chloroprene	000126-99-8
Chloropropane, 1,2-dibromo-3-	000096-12-8
Chlorothiophos	021923-23-9
Chloroxuron	001982-47-4
Chromic Chloride	010025-73-7
Chromium	007440-47-3
Chromium Compounds (As Cr) (does not include Cr VI cmpds)	
Chrysene	000218-01-9
Chrysotile	012001-29-5
Coal Tar Pitch Volatiles (as benzene solubles)	065996-93-2
Cobalt Carbonyl	010210-68-1
Cobalt Compounds	
Cobalt, ((2,2-(1,2-Ethanediylbis (nitrilo-methylidyne))Bis (6-fluorophenolato))(2-)-NNOO)	062207-76-5
Coke Oven Emissions	
Colchicine	000064-86-8
Copper	007440-50-8
Copper (dusts and mists)	007440-50-8
Copper (fume)	007440-50-8
Coumaphos	000056-72-4
Coumatetralyl	005836-29-3
Cresols/Cresylic Acid (isomers and mixture) (cresol)	001319-77-3
Cresols/Cresylic Acid (isomers and mixture) (m-cresol)	000108-39-4
Cresols/Cresylic Acid (isomers and mixture) (o-cresol)	000095-48-7
Cresols/Cresylic Acid (isomers and mixture) (p-cresol)	000106-44-5
Crimidine	000535-89-7
Crocidolite	012001-28-4

Chemical	CAS Number
Crotonaldehyde	004170-30-3
Crotonaldehyde, (E)-	000123-73-9
Cumene (Isopropylbenzene)	000098-82-8
Cyanide Compounds (as free cyanide)	
Cyanogen Bromide	000506-68-3
Cyanogen Iodide	000506-78-5
Cyanophos	002636-26-2
Cyanuric Fluoride	000675-14-9
Cycloheximide	000066-81-9
Cyclohexylamine	000108-91-8
Cyclopentane	000287-92-3
Cyclopentene	000142-29-0
DDE	003547-04-4
DEHP (Bis(2-ethylhexyl)phthalate)	000117-81-7
Decaborane (14)	017702-41-9
Demeton	008065-48-3
Demeton-S-Methyl	000919-86-8
Dialifor	010311-84-9
Diazomethane	000334-88-3
Dibenz(a,h)anthracene	000053-70-3
Dibenzofuran	000132-64-9
Diborane	019287-45-7
Dibutylphthalate	000084-74-2
Dichlorobenzene, 1,4- (p)	000106-46-7
Dichlorobenzidine, 3,3'-	000091-94-1
Dichlorobutene, Trans-1,4-	000110-57-6
Dichloroethyl Ether (Bis(2-chloroethyl)ether)	000111-44-4
Dichloromethylphenylsilane	000149-74-6
Dichlorophenoxyacetic Acid, 2,4- (2,4-D) salts and esters	000094-75-7
Dichloropropene, 1,3-	000542-75-6
Dichlorvos (DDVP)	000062-73-7
Dicrotophos (Bidrin)	000141-66-2
Diepoxide	
Diepoxybutane	001464-53-5
Diethanolamine	000111-42-2
Diethyl Chlorophospate	000814-49-3
Diethyl Phthalate	000084-66-2
Diethyl Sulfate	000064-67-5
Diethylcarbamazine Citrate	001642-54-2
Diethylenetriamine	000111-40-0
Diethylhexylsebacate	

Chemical	CAS Number
Digitoxin	000071-63-6
Diglycidyl Ether	002238-07-5
Digoxin	020830-75-5
Diisopropylmethylphosphonate	001445-75-6
Dimefox	000115-26-4
Dimethoate	000060-51-5
Dimethoxybenzidine, 3,3'-	000119-90-4
Dimethyl Aminoazobenzene	000060-11-7
Dimethyl Carbamoyl Chloride	000079-44-7
Dimethyl Formamide	000068-12-2
Dimethyl Phosphorochloridothioate	002524-03-0
Dimethyl Phthalate	000131-11-3
Dimethyl Sulfate	000077-78-1
Dimethyl-p-Phenylenediamine	000099-98-9
Dimethylaniline (N,N-Dimethylaniline)	000121-69-7
Dimethylbenzidine, 3,3'-	000119-93-7
Dimethylbutane, 2,2-	000075-83-2
Dimethylbutane, 2,3-	000079-29-8
Dimethyldichlorosilane	000075-78-5
Dimethylhexane, 2,3-	
Dimethylhexane, 2,4-	
Dimethylhydrazine	000057-14-7
Dimethylpentane, 2,4-	000108-08-7
Dimethylphenethylamine, alpha, alpha-	
Dimetilan	000644-64-4
Dinitro-o-cresol, 4,6- and salts	000534-52-1
Dinitrobenzene, 1,3-	000099-65-0
Dinitrobenzenes (all isomers)	025154-54-5
Dinitrocresol	000534-52-1
Dinitrophenol, 2,4-	000051-28-5
Dinitropyrene, 1,6-	042397-64-8
Dinitrotoluene	025321-14-6
Dinitrotoluene, 2,4-	000121-14-2
Dinitrotoluene, 2,6-	000606-20-2
Dinitrotoluene, Mixture	
Dinoseb	000088-85-7
Dinoterb	001420-07-1
Dioctyl Sebacate	000122-62-3
Dioxane, 1,4- (1,4-Diethyleneoxide)	000123-91-1
Dioxathion	000078-34-2
Diphacinone	000082-66-6
Diphenylamine	000122-39-4

CHEMICALS LISTED IN ALPHABETICAL ORDER

Chemical	CAS Number
Diphenylhydrazine, 1,2-	000122-66-7
Diphenyloxazole, 2,5-	000092-71-7
Diphosphoramide, Octamethyl-	000152-16-9
Disulfoton	000298-04-4
Dithiazanine Iodide	000514-73-8
Dithiobiuret	000541-53-7
EPN	002104-64-5
Emetine, Dihydrochloride	000316-42-7
Endosulfan	000115-29-7
Endothion	002778-04-3
Endrin	000072-20-8
Epichlorohydrin	000106-89-8
Epoxybutane, 1,2-	000106-88-7
Ergocalciferol	000050-14-6
Ergotamine Tartrate	000379-79-3
Ethane	000074-84-0
Ethanesulfonyl Chloride, 2-Chloro	001622-32-8
Ethanol, 1,2-Dichloro-, Acetate	010140-87-1
Ethion	000563-12-2
Ethoprophos	013194-48-4
Ethybis(2-Chloroethyl)amine	000538-07-8
Ethyl Acrylate	000140-88-5
Ethyl Benzene	000100-41-4
Ethyl Carbamate (Urethane)	000051-79-6
Ethyl Chloride (Chloroethane)	000075-00-3
Ethylcyclohexane	001678-91-7
Ethylene	000074-85-1
Ethylene Dibromide (Dibromoethane)	000106-93-4
Ethylene Dichloride (1,2-Dichloroethane)	000107-06-2
Ethylene Fluorohydrin	000371-62-0
Ethylene Glycol	000107-21-1
Ethylene Oxide	000075-21-8
Ethylene Thiourea	000096-45-7
Ethylenediamine	000107-15-3
Ethyleneimine	000151-56-4
Ethylhexane, 3-	000619-99-8
Ethylidene Dichloride (1,1-Dichloroethane)	000075-34-3
Ethylthiocyanate	000542-90-5
Ethyltoluene, 1-	
Ethyltoluene, 2-	000611-14-3
Ethyltoluene, 3-	000620-14-4
Fenamiphos	022224-92-6

Chemical	CAS Number
Fenitrothion	000122-14-5
Fensulfothion	000115-90-2
Fluenetil	004301-50-2
Fluoranthene	000206-44-0
Fluorene	000086-73-7
Fluorine	007782-41-4
Fluoroacetamide	000640-19-7
Fluoroacetic Acid	000144-49-0
Fluoroacetyl Chloride	000359-06-8
Fluorouracil	000051-21-8
Fonofos	000944-22-9
Formaldehyde	000050-00-0
Formaldehyde Cyanohydrin	000107-16-4
Formetanate Hydrochloride	023422-53-9
Formothion	002540-82-1
Formparanate	017702-57-7
Fosthietan	021548-32-3
Fuberidazole	003878-19-1
Furan	000110-00-9
Gallium	007440-55-3
Gallium Trichloride	013450-90-3
Germanium	007440-56-4
Glycol Ethers	
HMX (Cyclotetramethylene Tetranitramine)	002691-41-0
Heptachlor	000076-44-8
Heptane, n-	000142-82-5
Hexachlorobenzene	000118-74-1
Hexachlorobutadiene	000087-68-3
Hexachlorocyclopentadiene	000077-47-4
Hexachloroethane	000067-72-1
Hexamethylene-1,6-diisocyanate	000822-06-0
Hexamethylenediamine, N,N-dibutyl-	004835-11-4
Hexamethylphosphoramide	000680-31-9
Hexane, n-	000110-54-3
Hexene, 1-	000592-41-6
Hexene, cis-2-	
Hexene, trans-2-	004050-45-7
Hydrazine	000302-01-2
Hydrochloric Acid or (Hydrogen chloride)	007647-01-0
Hydrocyanic Acid or (Hydrogen cyanide)	000074-90-8
Hydrogen Chloride, Anhydrous	007647-01-0
Hydrogen Fluoride (Hydrofluoric acid)	007664-39-3

Chemical	CAS Number
Hydrogen Peroxide (saturated)	007722-84-1
Hydrogen Selenide	007783-07-5
Hydrogen Sulfide	007783-06-4
Hydroquinone	000123-31-9
Iodine	007553-56-2
Iron	007439-89-6
Iron (soluble salts)	
Iron, Pentacarbonyl-	013463-40-6
Isobenzan	000297-78-9
Isobutyronitrile	000078-82-0
Isocyanic Acid, 3,4-Dichlorophenyl Ester	000102-36-3
Isodrin	000465-73-6
Isofluorphate	000055-91-4
Isophorone	000078-59-1
Isophorone Diisocyanate	004098-71-9
Isoprene	000078-79-5
Isopropyl Chloroformate	000108-23-6
Isopropymethylpyrazolyl Dimethylcarbamate	000119-38-0
Ketone, Bis(Chloromethyl)	000534-07-6
Lactonitrile	000078-97-7
Lead (Inorganic dusts and fume)	
Lead (inorganic)	007439-92-1
Lead (metal)	007439-92-1
Lead Azide	013424-46-9
Lead Compounds (as Pb)	
Lead Styphnate	015245-44-0
Lead, Tetraethyl	000078-00-2
Lead, Tetramethyl	000075-74-1
Leptophos	021609-90-5
Lewisite	000541-25-3
Limonene, delta-	005989-27-5
Lindane	000058-89-9
Lithium Hydride	007580-67-8
Magnesium	007439-95-4
Magnesium Oxide (fume)	001309-48-4
Maleic Anhydride	000108-31-6
Malononitrile	000109-77-3
Manganese	007439-96-5
Manganese (Dust and compounds)	
Manganese (fume)	007439-96-5
Manganese Compounds (as Mn)	
Manganese, Tricarbonyl Methylcyclopentadienyl	012108-13-3

CHEMICALS LISTED IN ALPHABETICAL ORDER

Chemical	CAS Number
Mechlorethamine	000051-75-2
Mephosfolan	000950-10-7
Mercuric Acetate	001600-27-7
Mercuric Chloride	007487-94-7
Mercuric Oxide	021908-53-2
Mercury	007439-97-6
Mercury (Alkyl compounds)	
Mercury (Aryl & inorganic compounds)	
Mercury (Inorganic)	
Mercury (vapor)	007439-97-6
Mercury Fulminate	000628-86-4
Methacrolein Diacetate	010476-95-6
Methacrylic Anhydride	000760-93-0
Methacrylonitrile	000126-98-7
Methacryloyl Chloride	000920-46-7
Methacryloyloxyethyl Isocyanate	030674-80-7
Methamidophos	010265-92-6
Methane	000074-82-8
Methanesulfonyl Fluoride	000558-25-8
Methanol	000067-56-1
Methidathion	000950-37-8
Methiocarb	002032-65-7
Methiocarb	001129-41-5
Methomyl	016752-77-5
Methoxychlor	000072-43-5
Methoxyethylmercuric Acetate	000151-38-2
Methyl 2-Chloroacrylate	000080-63-7
Methyl Bromide (Bromomethane)	000074-83-9
Methyl Chloride (Chloromethane)	000074-87-3
Methyl Chloroformate	000079-22-1
Methyl Ethyl Ketone (2-Butanone)	000078-93-3
Methyl Hydrazine	000060-34-4
Methyl Iodide (Iodomethane)	000074-88-4
Methyl Isobutyl Ketone (Hexone)	000108-10-1
Methyl Isocyanate	000624-83-9
Methyl Isothiocyanate	000556-61-6
Methyl Mercaptan	000074-93-1
Methyl Methacrylate	000080-62-6
Methyl Phenkapton	003735-23-7
Methyl Phosphonic Dichloride	000676-97-1
Methyl Tert Butyl Ether	001634-04-4
Methyl Thiocyanate	000556-64-9

Chemical	CAS Number
Methyl Vinyl Ketone	000078-94-4
Methyl chloroform (1,1,1-Trichloroethane)	000071-55-6
Methyl-1-Butene, 2-	000563-46-2
Methyl-1-Butene, 3-	000563-45-1
Methyl-1-Pentene, 2-	000763-29-1
Methyl-1-Pentene, 4-	000691-37-2
Methyl-2-Butene, 2-	000513-35-9
Methyl-2-Pentene, 2-	000625-27-4
Methylcyclohexane	000108-87-2
Methylcyclopentane	000096-37-7
Methylene Chloride (Dichloromethane)	000075-09-2
Methylene Diphenyl Diisocyanate (MDI)	000101-68-8
Methylene bis(2-chloroaniline), 4,4'-	000101-14-4
Methylenedianiline, 4,4'-	000101-77-9
Methylheptane, 2-	
Methylhexane, 3-	000589-34-4
Methylhydantoin, 5-Ethyl-1,3-diglycidyl-5-	000592-27-8
Methylmercuric Dicyanamide	000502-39-6
Methylnaphthalene, 2-	000091-57-6
Methylpentane, 2-	000107-83-5
Methylpentane, 3-	000096-14-0
Methyltrichlorosilane	000075-79-6
Methytlnaphthalene, 1-	001321-94-4
Mevinphos (Phosdrin)	007786-34-7
Mexacarbate	000315-18-4
Mineral fibers	
Mitomycin C	000050-07-7
Molybdenum	007439-98-7
Molybdenum (Insoluble compounds)	
Molybdenum (Soluble compounds)	
Monocrotophos	006923-22-4
Monoethylamine (Ethylamine)	000075-04-7
Muscimol	002763-94-4
Mustard Gas	000505-60-2
Myrcene	000123-35-3
Naphthalene	000091-20-3
Naphthaleneamine, 2-	
Naphthylamine, 2-	000091-59-8
Nickel	007440-02-0
Nickel (Metal)	007440-02-0
Nickel (Refinery dust)	007440-02-0
Nickel (Soluble compounds)	

Chemical	CAS Number
Nickel (Soluble salts)	
Nickel Carbonyl	013463-39-3
Nicotine	000054-11-5
Nicotine Sulfate	000065-30-5
Nitric Acid	007697-37-2
Nitric Oxide	010102-43-9
Nitrobenzene	000098-95-3
Nitrobiphenyl, 4- (or 4-Nitrodiphenyl)	000092-93-3
Nitrocellulose	009004-70-0
Nitrocyclohexane	001122-60-7
Nitrodiphenylamine, 2-	000199-75-5
Nitrodiphenylamine, 4-	000836-30-6
Nitrogen Dioxide	010102-44-0
Nitroglycerine	000055-63-0
Nitroguanidine	000556-88-7
Nitromethane	000075-52-5
Nitronaphthalene, 2-	000581-89-5
Nitrophenol, 4-	000100-02-7
Nitrophenol, o-	000088-75-5
Nitropropane, 2-	000079-46-9
Nitropyrene, 1-	
Nitroso-N-methylurea, N-	000684-93-5
Nitrosoethylamine, N-	
Nitrosodimethylamine, N-	000062-75-9
Nitrosodiphenylamine, 4-	000156-10-5
Nitrosodiphenylamine, N-	000086-30-6
Nitrosomorpholine, N-	000059-89-2
Nonane, n-	000111-84-2
Norbormide	000991-42-4
Octane, n-	000111-65-9
Organorhodium Complex (PMN-92-147)	
Ouabain	000630-60-4
Oxamyl	023135-22-0
Oxetane, 3,3-Bis(chloromethyl)-	000078-71-7
Oxydisulfoton	002497-07-6
Ozone	010028-15-6
Paraquat	004685-14-7
Paraquat Methosulfate	002074-50-2
Parathion	000056-38-2
Parathion, Methyl	000298-00-0
Paris Green	012002-03-8
Particulates (PM10)	

CHEMICALS LISTED IN ALPHABETICAL ORDER

Chemical	CAS Number
Particulates (PM10, total dust)	
Pentaborane	019624-22-7
Pentachloronitrobenzene (Quintobenzene)	000082-68-8
Pentachlorophenol	000087-86-5
Pentadecylamine	002570-26-5
Pentaerythritol Tetranitrate (PETN)	000078-11-5
Pentene	025377-72-4
Pentene, 1-	000109-67-1
Pentene, cis-2-	000627-20-3
Pentene, trans-2-	000646-04-8
Peracetic Acid	000079-21-0
Perchloromethylmercaptan	000594-42-3
Phenanthrene	000085-01-8
Phenol	000108-95-2
Phenol, 2,2 Thiobis(4-chloro-6-methyl)-	004418-66-0
Phenol, 3-(1 Methylethyl)-, Methylcarbamate	000064-00-6
Phenoxarsine, 10, 10-Oxydi-	000058-36-6
Phenyl Dichloroarsine	000696-28-6
Phenyldiisodecyl Phosphite	
Phenylenediamine, p	000106-50-3
Phenylhydrazine Hydrochloride	000059-88-1
Phenylmercury Acetate	000062-38-4
Phenylsilatrane	002097-19-0
Phenylthiourea	000103-85-5
Phorate	000298-02-2
Phosacetim	004104-14-7
Phosfolan	000947-02-4
Phosgene	000075-44-5
Phosmet	000732-11-6
Phosphamidon	013171-21-6
Phosphine	007803-51-2
Phosphonothioic Acid, Methyl-, O-(4-nitrophenyl) O-phenyl ester	002665-30-7
Phosphonothioic Acid, Methyl-, O-ethyl O-(4-(methylthio)phenyl) ester	002703-13-1
Phosphonothioic Acid, Methyl-, S-(2-(Bis(1-methylethyl)amino)ethyl O-ethyl ester	050782-69-9
Phosphoric Acid, Dimethyl 4-(methylthio) phenyl ester	003254-63-5
Phosphorothioic Acid, O,O-Dimethyl-S-(2-methylthio)ethyl ester	002587-90-8
Phosphorus	007723-14-0
Phosphorus (white, yellow)	007723-14-0
Phosphorus Oxychloride	010025-87-3

Chemical	CAS Number
Phosphorus Pentachloride	010026-13-8
Phosphorus Pentoxide	001314-56-3
Phosphorus Trichloride	007719-12-2
Phthalic Anhydride	000085-44-9
Physostigmine	000057-47-6
Physotigmine, Salicylate (1:1)	000057-64-7
Picric acid	000088-89-1
Picrotoxin	000124-87-8
Pinene, alpha-	000080-56-8
Pinene, beta-	000127-91-3
Piperidine	000110-89-4
Pirimifos, Ethyl	023505-41-1
Polychlorinated Biphenyls (Aroclors)	001336-36-3
Polycylic Organic Matter	
Polystyrene	009003-53-6
Potassium	007440-09-7
Potassium Arsenide	010124-50-2
Potassium Cyanide	000151-50-8
Potassium Hydroxide	001310-58-3
Potassium Nitrate	007757-79-1
Potassium Silver Cyanide	000506-61-6
Promecarb	002631-37-0
Propane	000074-98-6
Propane Sultone, 1,3-	001120-71-4
Propargyl Bromide	000106-96-7
Propiolactone, Beta-	000057-57-8
Propionaldehyde	000123-38-6
Propionitrile	000107-12-0
Propionitrile, 3-Chloro-	000542-76-7
Propiophenone, 4-Amino-	000070-69-9
Propoxur (Baygon)	000114-26-1
Propyl Adipate, di-N-	000106-19-4
Propyl Chloroformate	000109-61-5
Propylbenzene, 1-	000103-65-1
Propylene Dichloride (1,2-Dichloropropane)	000078-87-5
Propylene Oxide	000075-56-9
Propyleneimine	000075-55-8
Prothoate	002275-18-5
Pyrene	000129-00-0
Pyridine, 2-Methyl-5-Vinyl-	000140-76-1
Pyridine, 4-Amino-	000504-24-5
Pyridine, 4-Nitro-, 1-Oxide	001124-33-0

Chemical	CAS Number
Pyriminil	053558-25-1
Quinoline	000091-22-5
Quinone	000106-51-4
RDX (Cyclo-1,3,5-trimethylene-2,4,6-trinitramine)	000121-82-4
Radionuclides (Includes radon, See entries for specific compounds)	
Resorcinol	000108-46-3
Salane, (4-Aminobutyl)diethoxymethyl-	003037-72-7
Salcomine	014167-18-1
Salicylic Acid	000069-72-7
Sarin	000107-44-8
Selenious Acid	007783-00-8
Selenium	007782-49-2
Selenium Compounds (as Se)	
Selenium Oxychloride	007791-23-3
Semicarbazide Hydrochloride	000563-41-7
Silane, Trichloro(chloromethyl)-	001558-25-4
Silane, Trichloro(dichlorophenyl)-	027137-85-5
Silicon	007440-21-3
Silicon (Total dust)	007440-21-3
Silver (Metal dust and fume)	007440-22-4
Silver (Metal dust and soluble compounds)	
Silver (Metal dust, soluble compounds, and fumes)	
Silver (Soluble compounds)	
Silver (metal)	007440-22-4
Sodium Arsenate	007631-89-2
Sodium Arsenite	007784-46-5
Sodium Azide	026628-22-8
Sodium Cacodylate	000124-65-2
Sodium Cyanide	000143-33-9
Sodium Fluoroacetate	000062-74-8
Sodium Nitrate	007631-99-4
Sodium Selenate	013410-01-0
Sodium Selenite	010102-18-8
Sodium Tellurite	010102-20-2
Stannane, Acetoxytriphenyl-	000900-95-8
Strontium	007440-24-6
Strychnine	000057-24-9
Strychnine Sulfate	000060-41-3
Styrene	000100-42-5
Styrene Oxide	000096-09-3
Sulfotep (Tetraethyldithiopyrophosphate or TEDP)	003689-24-5

CHEMICALS LISTED IN ALPHABETICAL ORDER

Chemical	CAS Number
Sulfoxide, 3-Chloropropyl octyl	003569-57-1
Sulfur	007704-34-9
Sulfur Dioxide	007446-09-5
Sulfur Dioxide, Anhydrous	
Sulfur Tetrafluoride	007783-60-0
Sulfur Trioxide	007446-11-9
Sulfuric Acid	007664-93-9
TEPP	000107-49-3
Tabun	000077-81-6
Tellurium	013494-80-9
Tellurium Hexafluoride	007783-80-4
Terbufos	013071-79-9
Terpinene, alpha-	000099-86-5
Terpinene, delta-	
Terpinolene	000586-62-9
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	001746-01-6
Tetrachloroethane, 1,1,2,2-	000079-34-5
Tetrachloroethylene (Perchloroethylene)	000127-18-4
Tetranitromethane	000509-14-8
Tetryl (Trinitro-2,4-6-phenylmethylnitramine)	000479-45-8
Thallium Sulfate	010031-59-1
Thallous Carbonate	006533-73-9
Thallous Chloride	007791-12-0
Thallous Malonate	002757-18-8
Thallous Sulfate	007446-18-6
Thiocarbazide	002231-57-4
Thiofanox	039196-18-4
Thionazin	000297-97-2
Thiophenol	000108-98-5
Thiosemicarbazide	000079-19-6
Thiourea, (2-Chlorophenyl)-	005344-82-1
Thiourea, (2-Methylphenyl)-	000614-78-8
Tin (Metal)	007440-31-5
Tin (Organic compounds)	
Tin (Oxide and inorganic compounds except SnH4)	
Tin (and compounds)	
Tin (inorganic compounds except oxides)	007440-31-5
Tin, Tetraethyl	000597-64-8
Titanium	007440-32-6
Titanium Tetrachloride	007550-45-0
Toluene	000108-88-3
Toluene 2,6-Diisocyanate	000091-08-7

Chemical	CAS Number
Toluene Diamine, 2,4-	000095-80-7
Toluene Diisocyanate	026471-62-5
Toluene, 2,4-Diisocyanate	000584-84-9
Toluidine, o-	000095-53-4
Toxaphene (Chlorinated camphene)	008001-35-2
Triacetin	000102-76-1
Triamiphos	001031-47-6
Triazofos	024017-47-8
Trichloroacetyl Chloride	000076-02-8
Trichlorobenzene, 1,2,4-	000120-82-1
Trichloroethane, 1,1,2-	000079-00-5
Trichloroethylene	000079-01-6
Trichloroethylsilane	000115-21-9
Trichloronate	000327-98-0
Trichlorophenol, 2,4,5-	000095-95-4
Trichlorophenol, 2,4,6-	000088-06-2
Trichlorophenylsilane	000098-13-5
Triethoxysilane	000998-30-1
Triethylamine	000121-44-8
Trifluralin	001582-09-8
Trimethyl-3-phenylindane, 1,1,3-	003910-35-8
Trimethylbenzene, 1,2,4-	000095-63-6
Trimethylbenzene, 1,3,5-	000108-67-8
Trimethylchlorosilane	000075-77-4
Trimethylolpropane Phosphite	000824-11-3
Trimethylpentane, 2,2,3-	054665-47-3
Trimethylpentane, 2,2,4-	000540-84-1
Trimethylpentane, 2,3,4-	000565-75-3
Trimethyltin Chloride	001066-45-1
Trinitroanisole	028653-16-9
Trinitrobenzene, 1,3,5-	000099-35-4
Trinitroglycerol	000055-63-0
Trinitrotoluene, 2,4,6-	000118-96-7
Triphenyltin Chloride	000639-58-7
Tris(2-Chloroethyl) Amine	000555-77-1
Uranium	007440-61-1
Uranium (Insoluble compounds)	
Uranium (Natural)	007440-61-1
Uranium (Soluble and insoluble compounds)	
Uranium (Soluble compounds)	
Uranium Soluble Salts	
Valinomycin	002001-95-8

Chemical	CAS Number
Vanadium	007440-62-2
Vanadium Pentoxide (as V2O5)	001314-62-1
Vinyl Acetate	000108-05-4
Vinyl Bromide	000593-60-2
Vinyl Chloride	000075-01-4
Vinylidene Chloride (1,1-Dichloroethylene)	000075-35-4
Warfarin	000081-81-2
Warfarin, Sodium	000129-06-6
Xylene (all isomers)	001330-20-7
Xylene Dichloride	028347-13-9
Xylene, m-	000108-38-3
Xylene, o-	000095-47-6
Xylene, p-	000106-42-3
Xylenes (isomers and mixture)	001330-20-7
Xylenes (isomers and mixture) -m	000108-38-3
Xylenes (isomers and mixture) -o	000095-47-6
Xylenes (isomers and mixture) -p	000106-42-3
Zinc (metallic)	007440-66-6
Zinc Oxide (dust)	001314-13-2
Zinc Oxide (fume)	001314-13-2
Zinc Phosphide	001314-84-7
Zinc, Dichloro(4,4-dimethyl-5(((methylamino) carbonyl)oxy)imino)pentanenitrile)-(T-4)	058270-08-9
Zirconium (and compounds)	

CHEMICALS LISTED IN CAS NUMBER ORDER

CHEMICALS LISTED IN CAS NUMBER ORDER

CAS Number	Chemical
	Aluminum (alkyls)
	Aluminum (pyro powders)
	Aluminum (soluble salts)
	Antimony Compounds (as Sb)
	Arsenic (Inorganic compounds)
	Arsenic (Organic compounds)
	Barium (Soluble compounds)
	Benzo(c)acridine
	Beryllium Compounds (as Be)
	Butane, i-
	Butene, i-
	Butylphenol, 2,2-Methylene bis(4-methyl) 6-t-butylphen-
	Cadmium (dusts and salts)
	Cadmium Compounds (as Cd)
	Chromium Compounds (As Cr) (does not include Cr VI cmpds)
	Cobalt Compounds
	Coke Oven Emissions
	Cyanide Compounds (as free cyanide)
	Diepoxide
	Diethylhexylsebacate
	Dimethylhexane, 2,3-
	Dimethylhexane, 2,4-
	Dimethylphenethylamine, alpha, alpha-
	Dinitrotoluene, Mixture
	Ethyltoluene, 1-
	Glycol Ethers
	Hexene, cis-2-
	Iron (soluble salts)
	Lead (Inorganic dusts and fume)
	Lead Compounds (as Pb)
	Manganese (Dust and compounds)
	Manganese Compounds (as Mn)
	Mercury (Alkyl compounds)
	Mercury (Aryl & inorganic compounds)
	Mercury (Inorganic)
	Methylheptane, 2-
	Mineral fibers
	Molybdenum (Insoluble compounds)
	Molybdenum (Soluble compounds)
	Naphthaleneamine, 2-
	Nickel (Soluble compounds)
	Nickel (Soluble salts)
	Nitropyrene, 1-
	Nitrosochethylamine, N-
	Organorthodium Complex (PMN-92-147)
	Particulates (PM10)
	Particulates (PM10, total dust)
	Phenyldiisodecyl Phosphite
	Polycylic Organic Matter
	Radionuclides (Includes radon, See entries for specific compounds)
	Selenium Compounds (as Se)
	Silver (Metal dust and soluble compounds)
	Silver (Metal dust, soluble compounds, and fumes)
	Silver (Soluble compounds)
	Sulfur Dioxide, Anhydrous
	Terpinene, delta-
	Tin (Organic compounds)
	Tin (Oxide and inorganic compounds except SnH4)
	Tin (and compounds)
	Uranium (Insoluble compounds)
	Uranium (Soluble and Insoluble compounds)
	Uranium (Soluble compounds)
	Uranium Soluble Salts
	Zirconium (and compounds)
000050-00-0	Formaldehyde
000050-07-7	Mitomycin C
000050-14-6	Ergocalciferol
000050-32-8	Benzo(a)pyrene (also see Coal Tar Pitch Volatiles)
000051-21-8	Fluorouracil
000051-28-5	Dinitrophenol, 2,4-
000051-75-2	Mechlorethamine
000051-79-6	Ethyl Carbamate (Urethane)
000051-83-2	Carbachol Chloride
000053-70-3	Dibenz(a,h)anthracene
000053-96-3	Acetylaminofluorene, 2-
000054-11-5	Nicotine
000054-62-6	Aminopterin
000055-63-0	Nitroglycerine
000055-63-0	Trinitroglycerol
000055-91-4	Isofluorphate
000056-23-5	Carbon Tetrachloride
000056-25-7	Cantharidin
000056-38-2	Parathion
000056-55-3	Benzo(a)anthracene
000056-72-4	Coumaphos
000057-14-7	Dimethylhydrazine
000057-24-9	Strychnine
000057-47-6	Physostigmine
000057-57-8	Propiolactone, Beta-
000057-64-7	Physotigmine, Salicylate (1:1)
000057-74-9	Chlordane
000058-36-6	Phenoxarsine, 10, 10-Oxydi-
000058-89-9	Lindane
000059-88-1	Phenylhydrazine Hydrochloride
000059-89-2	Nitrosomorpholine, N-
000060-11-7	Dimethyl Aminoazobenzene
000060-34-4	Methyl Hydrazine
000060-35-5	Acetamide
000060-41-3	Strychnine Sulfate
000060-51-5	Dimethoate
000062-38-4	Phenylmercury Acetate
000062-53-3	Aniline
000062-73-7	Dichlorvos (DDVP)
000062-74-8	Sodium Fluoroacetate
000062-75-9	Nitrosodimethylamine, N-
000063-25-2	Carbaryl
000064-00-6	Phenol, 3-(1 Methylethyl)-, Methylcarbamate
000064-67-5	Diethyl Sulfate
000064-86-8	Colchicine
000065-30-5	Nicotine Sulfate
000066-81-9	Cycloheximide
000067-56-1	Methanol
000067-66-3	Chloroform
000067-72-1	Hexachloroethane

CHEMICALS LISTED IN CAS NUMBER ORDER

CAS Number	Chemical
000068-12-2	Dimethyl Formamide
000069-72-7	Salicylic Acid
000070-69-9	Propiophenone, 4-Amino-
000071-43-2	Benzene
000071-55-6	Methyl chloroform (1,1,1-Trichloroethane)
000071-63-6	Digitoxin
000072-20-8	Endrin
000072-43-5	Methoxychlor
000074-82-8	Methane
000074-83-9	Methyl Bromide (Bromomethane)
000074-84-0	Ethane
000074-85-1	Ethylene
000074-86-2	Acetylene
000074-87-3	Methyl Chloride (Chloromethane)
000074-88-4	Methyl Iodide (Iodomethane)
000074-90-8	Hydrocyanic Acid or (Hydrogen cyanide)
000074-93-1	Methyl Mercaptan
000074-98-6	Propane
000075-00-3	Ethyl Chloride (Chloroethane)
000075-01-4	Vinyl Chloride
000075-04-7	Monoethylamine (Ethylamine)
000075-05-8	Acetonitrile
000075-07-0	Acetaldehyde
000075-09-2	Methylene Chloride (Dichloromethane)
000075-15-0	Carbon Disulfide
000075-21-8	Ethylene Oxide
000075-25-2	Bromoform
000075-34-3	Ethylidene Dichloride (1,1-Dichloroethane)
000075-35-4	Vinylidene Chloride (1,1-Dichloroethylene)
000075-44-5	Phosgene
000075-52-5	Nitromethane
000075-55-8	Propyleneimine
000075-56-9	Propylene Oxide
000075-74-1	Lead, Tetramethyl
000075-77-4	Trimethylchlorosilane
000075-78-5	Dimethyldichlorosilane
000075-79-6	Methyltrichlorosilane
000075-83-2	Dimethylbutane, 2,2-

CAS Number	Chemical
000075-86-5	Acetone Cyanohydrin
000076-02-8	Trichloroacetyl Chloride
000076-44-8	Heptachlor
000077-47-4	Hexachlorocyclopentadiene
000077-78-1	Dimethyl Sulfate
000077-81-6	Tabun
000078-00-2	Lead, Tetraethyl
000078-11-5	Pentaerythritol Tetranitrate (PETN)
000078-34-2	Dioxathion
000078-53-5	Amiton
000078-59-1	Isophorone
000078-71-7	Oxetane, 3,3-Bis(chloromethyl)-
000078-79-5	Isoprene
000078-82-0	Isobutyronitrile
000078-87-5	Propylene Dichloride (1,2-Dichloropropane)
000078-93-3	Methyl Ethyl Ketone (2-Butanone)
000078-94-4	Methyl Vinyl Ketone
000078-97-7	Lactonitrile
000079-00-5	Trichloroethane, 1,1,2-
000079-01-6	Trichloroethylene
000079-06-1	Acrylamide
000079-10-7	Acrylic Acid
000079-11-8	Chloracetic Acid
000079-19-6	Thiosemicarbazide
000079-21-0	Peracetic Acid
000079-22-1	Methyl Chloroformate
000079-29-8	Dimethylbutane, 2,3-
000079-34-5	Tetrachloroethane, 1,1,2,2-
000079-44-7	Dimethyl Carbamoyl Chloride
000079-46-9	Nitropropane, 2-
000080-56-8	Pinene, alpha-
000080-62-6	Methyl Methacrylate
000080-63-7	Methyl 2-Chloroacrylate
000081-81-2	Warfarin
000082-66-6	Diphacinone
000082-68-8	Pentachloronitrobenzene (Quintobenzene)
000084-66-2	Diethyl Phthalate
000084-74-2	Dibutylphthalate

CAS Number	Chemical
000085-01-8	Phenanthrene
000085-44-9	Phthalic Anhydride
000085-68-7	Butyl benzyl phthalate
000086-30-6	Nitrosodiphenylamine, N-
000086-50-0	Azinphos-Methyl
000086-73-7	Fluorene
000086-88-4	ANTU
000087-68-3	Hexachlorobutadiene
000087-86-5	Pentachlorophenol
000088-05-1	Aniline, 2,4,6-Trimethyl-
000088-06-2	Trichlorophenol, 2,4,6-
000088-75-5	Nitrophenol, o-
000088-85-7	Dinoseb
000088-89-1	Picric acid
000090-04-0	Anisidine, o-
000091-08-7	Toluene 2,6-Disocyanate
000091-20-3	Naphthalene
000091-22-5	Quinoline
000091-57-6	Methylnaphthalene, 2-
000091-59-8	Naphthylamine, 2-
000091-94-1	Dichlorobenzidine, 3,3'-
000092-52-4	Biphenyl (diphenyl)
000092-67-1	Aminobiphenyl, 4-
000092-71-7	Diphenyloxazole, 2,5-
000092-87-5	Benzidine
000092-93-3	Nitrobiphenyl, 4- (or 4-Nitrodiphenyl)
000094-75-7	Dichlorophenoxyacetic Acid, 2,4- (2,4-D) salts and esters
000095-47-6	Xylene, o-
000095-47-6	Xylenes (isomers and mixture) -o
000095-48-7	Cresols/Cresylic Acid (isomers and mixture) (o-cresol)
000095-53-4	Toluidine, o-
000095-63-6	Trimethylbenzene, 1,2,4-
000095-80-7	Toluene Diamine, 2,4-
000095-95-4	Trichlorophenol, 2,4,5-
000096-09-3	Styrene Oxide
000096-12-8	Chloropropane, 1,2-dibromo-3-
000096-14-0	Methylpentane, 3-
000096-37-7	Methylcyclopentane

CHEMICALS LISTED IN CAS NUMBER ORDER

CAS Number	Chemical
000096-45-7	Ethylene Thiourea
000098-05-5	Benzenearsonic Acid
000098-07-7	Benzotrichloride
000098-13-5	Trichlorophenylsilane
000098-16-8	Benzenamine, 3-(Trifluoromethyl)
000098-82-8	Cumene (Isopropylbenzene)
000098-86-2	Acetophenone
000098-87-3	Benzal Chloride
000098-95-3	Nitrobenzene
000099-35-4	Trinitrobenzene, 1,3,5-
000099-65-0	Dinitrobenzene, 1,3-
000099-86-5	Terpinene, alpha-
000099-98-9	Dimethyl-p-Phenylenediamine
000100-02-7	Nitrophenol, 4-
000100-14-1	Benzene, 1-(Chloromethyl)-4-nitro-
000100-41-4	Ethyl Benzene
000100-42-5	Styrene
000100-44-7	Benzyl Chloride
000100-51-6	Benzyl Alcohol
000101-14-4	Methylene bis(2-chloroaniline), 4,4'-
000101-68-8	Methylene Diphenyl Diisocyanate (MDI)
000101-77-9	Methylenedianiline, 4,4'-
000102-36-3	Isocyanic Acid, 3,4-Dichlorophenyl Ester
000102-76-1	Triacetin
000103-65-1	Propylbenzene, 1-
000103-85-5	Phenylthiourea
000105-60-2	Caprolactam (dust)
000106-19-4	Propyl Adipate, di-N-
000106-42-3	Xylene, p-
000106-42-3	Xylenes (isomers and mixture) -p
000106-44-5	Cresols/Cresylic Acid (isomers and mixture) (p-cresol)
000106-46-7	Dichlorobenzene, 1,4- (p)
000106-50-3	Phenylenediamine, p
000106-51-4	Quinone
000106-88-7	Epoxybutane, 1,2-
000106-89-8	Epichlorohydrin
000106-93-4	Ethylene Dibromide (Dibromoethane)
000106-96-7	Propargyl Bromide

CAS Number	Chemical
000106-97-8	Butane, n-
000106-98-9	Butene, 1-
000106-99-0	Butadiene, 1,3-
000107-02-8	Acrolein
000107-05-1	Allyl Chloride
000107-06-2	Ethylene Dichloride (1,2-Dichloroethane)
000107-07-3	Chloroethanol
000107-11-9	Allylamine
000107-12-0	Propionitrile
000107-13-1	Acrylonitrile
000107-15-3	Ethylenediamine
000107-16-4	Formaldehyde Cyanohydrin
000107-18-6	Allyl Alcohol
000107-21-1	Ethylene Glycol
000107-30-2	Chloromethyl Methyl Ether
000107-44-8	Sarin
000107-49-3	TEPP
000107-83-5	Methylpentane, 2-
000108-05-4	Vinyl Acetate
000108-08-7	Dimethylpentane, 2,4-
000108-10-1	Methyl Isobutyl Ketone (Hexone)
000108-23-6	Isopropyl Chloroformate
000108-31-6	Maleic Anhydride
000108-38-3	Xylene, m-
000108-38-3	Xylenes (isomers and mixture) -m
000108-39-4	Cresols/Cresylic Acid (isomers and mixture) (m-cresol)
000108-46-3	Resorcinol
000108-67-8	Trimethylbenzene, 1,3,5-
000108-87-2	Methylcyclohexane
000108-88-3	Toluene
000108-90-7	Chlorobenzene
000108-91-8	Cyclohexylamine
000108-95-2	Phenol
000108-98-5	Thiophenol
000109-61-5	Propyl Chloroformate
000109-67-1	Pentene, 1-
000109-77-3	Malononitrile
000110-00-9	Furan

CAS Number	Chemical
000110-54-3	Hexane, n-
000110-57-6	Dichlorobutene, Trans-1,4-
000110-89-4	Piperidine
000111-40-0	Diethylenetriamine
000111-42-2	Diethanolamine
000111-44-4	Dichloroethyl Ether (Bis(2-chloroethyl)ether)
000111-65-9	Octane, n-
000111-69-3	Adiponitrile
000111-84-2	Nonane, n-
000114-26-1	Propoxur (Baygon)
000115-21-9	Trichloroethylsilane
000115-26-4	Dimefox
000115-29-7	Endosulfan
000115-90-2	Fensulfothion
000116-06-3	Aldicarb
000117-81-7	DEHP (Bis(2-ethylhexyl)phthalate)
000118-74-1	Hexachlorobenzene
000118-96-7	Trinitrotoluene, 2,4,6-
000119-38-0	Isopropymethylpyrazolyl Dimethylcarbamate
000119-90-4	Dimethoxybenzidine, 3,3'-
000119-93-7	Dimethylbenzidine, 3,3'-
000120-12-7	Anthracene
000120-80-9	Catechol
000120-82-1	Trichlorobenzene, 1,2,4-
000121-14-2	Dinitrotoluene, 2,4-
000121-44-8	Triethylamine
000121-69-7	Dimethylaniline (N,N-Dimethylaniline)
000121-82-4	RDX (Cyclo-1,3,5-trimethylene-2,4,6-trinitramine)
000122-14-5	Fenitrothion
000122-39-4	Diphenylamine
000122-62-3	Dioctyl Sebacate
000122-66-7	Diphenylhydrazine, 1,2-
000123-31-9	Hydroquinone
000123-35-3	Myrcene
000123-38-6	Propionaldehyde
000123-73-9	Crotonaldehyde, (E)-
000123-91-1	Dioxane, 1,4- (1,4-Diethyleneoxide)
000124-65-2	Sodium Cacodylate

CHEMICALS LISTED IN CAS NUMBER ORDER

CAS Number	Chemical
000124-87-8	Picrotoxin
000126-98-7	Methacrylonitrile
000126-99-8	Chloroprene
000127-18-4	Tetrachloroethylene (Perchloroethylene)
000127-91-3	Pinene, beta-
000129-00-0	Pyrene
000129-06-6	Warfarin, Sodium
000131-11-3	Dimethyl Phthalate
000131-74-8	Ammonium Picrate
000132-64-9	Dibenzofuran
000133-06-2	Captan
000133-90-4	Chloramben
000135-98-8	Butylbenzene, sec-
000140-29-4	Benzyl Cyanide
000140-76-1	Pyridine, 2-Methyl-5-Vinyl-
000140-88-5	Ethyl Acrylate
000141-66-2	Dicrotophos (Bidrin)
000142-29-0	Cyclopentene
000142-82-5	Heptane, n-
000143-33-9	Sodium Cyanide
000144-49-0	Fluoroacetic Acid
000149-74-6	Dichloromethylphenylsilane
000151-38-2	Methoxyethylmercuric Acetate
000151-50-8	Potassium Cyanide
000151-56-4	Ethyleneimine
000152-16-9	Diphosphoramide, Octamethyl-
000156-10-5	Nitrosodiphenylamine, 4-
000156-62-7	Calcium Cyanamide
000199-75-5	Nitrodiphenylamine, 2-
000205-99-2	Benzo(b)fluoranthene
000206-44-0	Fluoranthene
000207-08-9	Benzo(k)fluoranthene
000218-01-9	Chrysene
000287-92-3	Cyclopentane
000297-78-9	Isobenzan
000297-97-2	Thionazin
000298-00-0	Parathion, Methyl
000298-02-2	Phorate
000298-04-4	Disulfoton
000300-62-9	Amphetamine
000302-01-2	Hydrazine
000309-00-2	Aldrin
000315-18-4	Mexacarbate
000316-42-7	Emetine, Dihydrochloride
000327-98-0	Trichloronate
000334-88-3	Diazomethane
000353-42-4	Boron Trifluoride Compound with Methyl Ether (1:1)
000359-06-8	Fluoroacetyl Chloride
000371-62-0	Ethylene Fluorohydrin
000379-79-3	Ergotamine Tartrate
000463-58-1	Carbonyl Sulfide
000465-73-6	Isodrin
000470-90-6	Chlorfenvinfos
000479-45-8	Tetryl (Trinitro-2,4-6-phenylmethylnitramine)
000502-39-6	Methylmercuric Dicyanamide
000504-24-5	Pyridine, 4-Amino-
000505-60-2	Mustard Gas
000506-61-6	Potassium Silver Cyanide
000506-68-3	Cyanogen Bromide
000506-78-5	Cyanogen Iodide
000509-14-8	Tetranitromethane
000510-15-6	Chlorobenzilate
000513-35-9	Methyl-2-Butene, 2-
000514-73-8	Dithiazanine Iodide
000532-27-4	Chloroacetophenone, 2-
000534-07-6	Ketone, Bis(Chloromethyl)
000534-52-1	Dinitro-o-cresol, 4,6- and salts
000534-52-1	Dinitrocresol
000535-89-7	Crimidine
000538-07-8	Ethybis(2-Chloroethyl)amine
000540-84-1	Trimethylpentane, 2,2,4-
000541-25-3	Lewisite
000541-53-7	Dithiobiuret
000542-75-6	Dichloropropene, 1,3-
000542-76-7	Propionitrile, 3-Chloro-
000542-88-1	Chloromethyl Ether
000542-90-5	Ethylthiocyanate
000555-77-1	Tris(2-Chloroethyl) Amine
000556-61-6	Methyl Isothiocyanate
000556-64-9	Methyl Thiocyanate
000556-88-7	Nitroguanidine
000558-25-8	Methanesulfonyl Fluoride
000563-12-2	Ethion
000563-41-7	Semicarbazide Hydrochloride
000563-45-1	Methyl-1-Butene, 3-
000563-46-2	Methyl-1-Butene, 2-
000565-75-3	Trimethylpentane, 2,3,4-
000581-89-5	Nitronaphthalene, 2-
000584-84-9	Toluene, 2,4-Diisocyanate
000586-62-9	Terpinolene
000589-34-4	Methylhexane, 3-
000590-18-1	Butene, cis-2-
000592-27-8	Methylhydantoin, 5-Ethyl-1,3-diglycidyl-5-
000592-41-6	Hexene, 1-
000593-60-2	Vinyl Bromide
000594-42-3	Perchloromethylmercaptan
000597-64-8	Tin, Tetraethyl
000606-20-2	Dinitrotoluene, 2,6-
000611-14-3	Ethyltoluene, 2-
000614-78-8	Thiourea, (2-Methylphenyl)-
000619-99-8	Ethylhexane, 3-
000620-14-4	Ethyltoluene, 3-
000624-64-6	Butene, trans-2-
000624-83-9	Methyl Isocyanate
000625-27-4	Methyl-2-Pentene, 2-
000627-11-2	Chloroethyl Chloroformate
000627-20-3	Pentene, cis-2-
000628-86-4	Mercury Fulminate
000630-08-0	Carbon Monoxide
000630-60-4	Ouabain
000639-58-7	Triphenyltin Chloride
000640-19-7	Fluoroacetamide
000644-64-4	Dimetilan
000646-04-8	Pentene, trans-2-

CHEMICALS LISTED IN CAS NUMBER ORDER

CAS Number	Chemical
000675-14-9	Cyanuric Fluoride
000676-97-1	Methyl Phosphonic Dichloride
000680-31-9	Hexamethylphosphoramide
000684-93-5	Nitroso-N-methylurea, N-
000691-37-2	Methyl-1-Pentene, 4-
000696-28-6	Phenyl Dichloroarsine
000732-11-6	Phosmet
000760-93-0	Methacrylic Anhydride
000763-29-1	Methyl-1-Pentene, 2-
000786-19-6	Carbophenothion
000814-49-3	Diethyl Chlorophospate
000814-68-6	Acrylyl Chloride
000822-06-0	Hexamethylene-1,6-diisocyanate
000824-11-3	Trimethylolpropane Phosphite
000836-30-6	Nitrodiphenylamine, 4-
000900-95-8	Stannane, Acetoxytriphenyl-
000919-86-8	Demeton-S-Methyl
000920-46-7	Methacryloyl Chloride
000944-22-9	Fonofos
000947-02-4	Phosfolan
000950-10-7	Mephosfolan
000950-37-8	Methidathion
000991-42-4	Norbormide
000998-30-1	Triethoxysilane
000999-81-5	Chlormequat Chloride
001031-47-6	Triamiphos
001066-45-1	Trimethyltin Chloride
001120-71-4	Propane Sultone, 1,3-
001122-60-7	Nitrocyclohexane
001124-33-0	Pyridine, 4-Nitro-, 1-Oxide
001129-41-5	Methicarb
001303-28-2	Arsenic Pentoxide
001306-19-0	Cadmium Oxide
001309-48-4	Magnesium Oxide (fume)
001310-58-3	Potassium Hydroxide
001314-13-2	Zinc Oxide (dust)
001314-13-2	Zinc Oxide (fume)
001314-56-3	Phosphorus Pentoxide
001314-62-1	Vanadium Pentoxide (as V205)
001314-84-7	Zinc Phosphide
001319-77-3	Cresols/Cresylic Acid (isomers and mixture) (cresol)
001321-94-4	Methylnaphthalene, 1-
001327-53-3	Arsenous Oxide
001330-20-7	Xylene (all isomers)
001330-20-7	Xylenes (isomers and mixture)
001332-21-4	Asbestos
001336-36-3	Polychlorinated Biphenyls (Aroclors)
001397-94-0	Antimycin A
001420-07-1	Dinoterb
001445-75-6	Diisopropylmethylphosphonate
001464-53-5	Diepoxybutane
001558-25-4	Silane, Trichloro(chloromethyl)-
001563-66-2	Carbofuran
001582-09-8	Trifluralin
001592-23-0	Calcium Stearate
001600-27-7	Mercuric Acetate
001622-32-8	Ethanesulfonyl Chloride, 2-Chloro
001634-04-4	Methyl Tert Butyl Ether
001642-54-2	Diethylcarbamazine Citrate
001678-91-7	Ethylcyclohexane
001746-01-6	Tetrachlorodibenzo-p-dioxin, 2,3,7,8-
001752-30-3	Acetone Thiosemicarbazide
001982-47-4	Chloroxuron
002001-95-8	Valinomycin
002032-65-7	Methiocarb
002074-50-2	Paraquat Methosulfate
002097-19-0	Phenylsilatrane
002104-64-5	EPN
002223-93-0	Cadmium Stearate
002231-57-4	Thiocarbazide
002238-07-5	Diglycidyl Ether
002275-18-5	Prothoate
002497-07-6	Oxydisulfoton
002524-03-0	Dimethyl Phosphorochloridothioate
002540-82-1	Formothion
002570-26-5	Pentadecylamine
002587-90-8	Phosphorothioic Acid, O,O-Dimethyl-S-(2-methylthio)ethyl ester
002631-37-0	Promecarb
002636-26-2	Cyanophos
002642-71-9	Azinphos-Ethyl
002665-30-7	Phosphonothioic Acid, Methyl-, O-(4-nitrophenyl) O-phenyl ester
002691-41-0	HMX (Cyclotetramethylene Tetranitramine)
002703-13-1	Phosphonothioic Acid, Methyl-, O-ethyl O-(4-(methyithio)phenyl) ester
002757-18-8	Thallous Malonate
002763-94-4	Muscimol
002778-04-3	Endothion
003037-72-7	Salane, (4-Aminobutyl)diethoxymethyl-
003254-63-5	Phosphoric Acid, Dimethyl 4-(methylthio) phenyl ester
003547-04-4	DDE
003569-57-1	Sulfoxide, 3-Chloropropyl octyl
003615-21-2	Benzimidazole, 4,5-Dichloro-2-(trifluoromethyl)
003689-24-5	Sulfotep (Tetraethyldithiopyrophosphate or TEDP)
003691-35-8	Chlorophacinone
003734-97-2	Amiton Oxalate
003735-23-7	Methyl Phenkapton
003878-19-1	Fuberidazole
003910-35-8	Trimethyl-3-phenylindane, 1,1,3-
004044-65-9	Bitoscanate
004050-45-7	Hexene, trans-2-
004098-71-9	Isophorone Diisocyanate
004104-14-7	Phosacetim
004170-30-3	Crotonaldehyde
004301-50-2	Fluenetil
004418-66-0	Phenol, 2,2 Thiobis(4-chloro-6-methyl)-
004685-14-7	Paraquat
004835-11-4	Hexamethylenediamine, N,N-dibutyl-
005344-82-1	Thiourea, (2-Chlorophenyl)-
005836-29-3	Coumatetralyl
005989-27-5	Limonene, delta-
006484-52-2	Ammonium Nitrate
006533-73-9	Thallous Carbonate
006923-22-4	Monocrotophos

CHEMICALS LISTED IN CAS NUMBER ORDER

CAS Number	Chemical
007429-90-5	Aluminum
007429-90-5	Aluminum (metal dust, respirable fraction)
007429-90-5	Aluminum (welding fume)
007439-89-6	Iron
007439-92-1	Lead (inorganic)
007439-92-1	Lead (metal)
007439-95-4	Magnesium
007439-96-5	Manganese
007439-96-5	Manganese (fume)
007439-97-6	Mercury
007439-97-6	Mercury (vapor)
007439-98-7	Molybdenum
007440-02-0	Nickel
007440-02-0	Nickel (Metal)
007440-02-0	Nickel (Refinery dust)
007440-09-7	Potassium
007440-21-3	Silicon
007440-21-3	Silicon (Total dust)
007440-22-4	Silver (Metal dust and fume)
007440-22-4	Silver (metal)
007440-24-6	Strontium
007440-31-5	Tin (Metal)
007440-31-5	Tin (inorganic compounds except oxides)
007440-32-6	Titanium
007440-36-0	Antimony
007440-38-2	Arsenic
007440-39-3	Barium
007440-41-7	Beryllium
007440-42-8	Boron
007440-43-9	Cadmium
007440-43-9	Cadmium (dust)
007440-43-9	Cadmium (fume)
007440-47-3	Chromium
007440-50-8	Copper
007440-50-8	Copper (dusts and mists)
007440-50-8	Copper (fume)
007440-55-3	Gallium
007440-56-4	Germanium

CAS Number	Chemical
007440-61-1	Uranium
007440-61-1	Uranium (Natural)
007440-62-2	Vanadium
007440-66-6	Zinc (metallic)
007440-70-2	Calcium
007446-09-5	Sulfur Dioxide
007446-11-9	Sulfur Trioxide
007446-18-6	Thallous Sulfate
007487-94-7	Mercuric Chloride
007550-45-0	Titanium Tetrachloride
007553-56-2	Iodine
007580-67-8	Lithium Hydride
007631-89-2	Sodium Arsenate
007631-99-4	Sodium Nitrate
007637-07-2	Boron Trifluoride
007647-01-0	Hydrochloric Acid or (Hydrogen chloride)
007647-01-0	Hydrogen Chloride, Anhydrous
007664-39-3	Hydrogen Fluoride (Hydrofluoric acid)
007664-41-7	Ammonia
007664-93-9	Sulfuric Acid
007697-37-2	Nitric Acid
007704-34-9	Sulfur
007719-12-2	Phosphorus Trichloride
007722-84-1	Hydrogen Peroxide (saturated)
007723-14-0	Phosphorus
007723-14-0	Phosphorus (white, yellow)
007726-95-6	Bromine
007757-79-1	Potassium Nitrate
007778-44-1	Calcium Arsenate
007782-41-4	Fluorine
007782-49-2	Selenium
007782-50-5	Chlorine
007783-00-8	Selenious Acid
007783-06-4	Hydrogen Sulfide
007783-07-5	Hydrogen Selenide
007783-60-0	Sulfur Tetrafluoride
007783-70-2	Antimony Pentafluoride
007783-80-4	Tellurium Hexafluoride

CAS Number	Chemical
007784-34-1	Arsenous Trichloride
007784-42-1	Arsine
007784-46-5	Sodium Arsenite
007786-34-7	Mevinphos (Phosdrin)
007791-12-0	Thallous Chloride
007791-23-3	Selenium Oxychloride
007803-51-2	Phosphine
008001-35-2	Camphechlor
008001-35-2	Toxaphene (Chlorinated camphene)
008065-48-3	Demeton
009003-53-6	Polystyrene
009004-70-0	Nitrocellulose
010022-31-8	Barium Nitrate
010025-73-7	Chromic Chloride
010025-87-3	Phosphorus Oxychloride
010026-13-8	Phosphorus Pentachloride
010028-15-6	Ozone
010031-59-1	Thallium Sulfate
010043-35-3	Boric Acid
010102-18-8	Sodium Selenite
010102-20-2	Sodium Tellurite
010102-43-9	Nitric Oxide
010102-44-0	Nitrogen Dioxide
010124-50-2	Potassium Arsenide
010140-87-1	Ethanol, 1,2-Dichloro-, Acetate
010210-68-1	Cobalt Carbonyl
010265-92-6	Methamidophos
010294-34-5	Boron Trichloride
010311-84-9	Dialifor
010476-95-6	Methacrolein Diacetate
012001-28-4	Crocidolite
012001-29-5	Chrysotile
012002-03-8	Paris Green
012108-13-3	Manganese, Tricarbonyl Methylcyclopentadienyl
012172-73-5	Amosite
013071-79-9	Terbufos
013171-21-6	Phosphamidon
013194-48-4	Ethoprophos

CHEMICALS LISTED IN CAS NUMBER ORDER

CAS Number	Chemical
013410-01-0	Sodium Selenate
013424-46-9	Lead Azide
013450-90-3	Gallium Trichloride
013463-39-3	Nickel Carbonyl
013463-40-6	Iron, Pentacarbonyl-
013494-80-9	Tellurium
014167-18-1	Salcomine
015245-44-0	Lead Styphnate
015271-41-7	Bicyclo [2.2.1] Heptane-2-carbonitrile, 5-chlor-6-((((methylamino)carbonyl) oxy)imino)-(1
016752-77-5	Methomyl
017702-41-9	Decaborane (14)
017702-57-7	Formparanate
019287-45-7	Diborane
019624-22-7	Pentaborane
020296-50-8	Carene, delta-3-
020830-75-5	Digoxin
020859-73-8	Aluminum Phosphide
021548-32-3	Fosthietan
021609-90-5	Leptophos
021908-53-2	Mercuric Oxide
021923-23-9	Chlorothiophos
022224-92-6	Fenamiphos
023135-22-0	Oxamyl
023422-53-9	Formetanate Hydrochloride
023505-41-1	Pirimifos, Ethyl
024017-47-8	Triazofos
024934-91-6	Chlormephos
025154-54-5	Dinitrobenzenes (all isomers)
025321-14-6	Dinitrotoluene
025377-72-4	Pentene
026419-73-8	Carbamic Acid, Methyl, O-(((2,4-dimethyl-1, 3-dithiolan-2-yl) methylene)amino)-
026471-62-5	Toluene Diisocyanate
026628-22-8	Sodium Azide
027137-85-5	Silane, Trichloro(dichloropheny)-
028347-13-9	Xylene Dichloride
028653-16-9	Trinitroanisole
028772-56-7	Bromadiolone

CAS Number	Chemical
030674-80-7	Methacryloyloxyethyl Isocyanate
039196-18-4	Thiofanox
042397-64-8	Dinitropyrene, 1,6-
050782-69-9	Phosphonothioic Acid, Methyl-, S-(2-(Bis(1-methylethyl)amino)ethyl O-ethyl ester
053558-25-1	Pyriminil
054665-47-3	Trimethylpentane, 2,2,3-
058270-08-9	Zinc, Dichloro(4,4-dimethyl-5(((methylamino) carbonyl)oxy)imino)pentanenitrile)-(T-4)
062207-76-5	Cobalt, ((2,2-(1,2-Ethanediylbis (nitrilo-methylidyne))Bis (6-fluorophenolato))(2-)-NNOO)
065996-93-2	Coal Tar Pitch Volatiles (as benzene solubles)

EPA HEALTH-BASED TOXICITY CRITERIA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk $(\mu g/L)^{-1}$	Oral: Slope Factor $(mg/kg/day)^{-1}$	Inhalation: Unit Risk $(\mu g/m^3)^{-1}$	Inhalation: Slope Factor $(mg/kg/day)^{-1}$	Risk Concentration: $\mu g/L$ at 10^{-5} Cancer Risk	Risk Concentration: $\mu g/m^3$ at 10^{-5} Cancer Risk
ANTU	000086-88-4	NA	NA	NA	NA	NA	NA	NA	NA
Acetaldehyde	000075-07-0	NA	9.00E-03 [a]	NA	NA	2.20E-06	NA	NA	5.00E+00 [a]
Acetamide	000060-35-5	NA	NA	NA	NA	NA	NA	NA	NA
Acetone Cyanohydrin	000075-86-5	7.00E-02 [b]	1.00E-02 [b]	NA	NA	NA	NA	NA	NA
Acetone Thiosemicarbazide	001752-30-3	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	000075-05-8	6.00E-03 [a]	5.00E-02 [a]	NA	NA	NA	NA	NA	NA
Acetophenone	000098-86-2	1.00E-01 [a]	2.00E-05 [a]	NA	NA	NA	NA	NA	NA
Acetylaminofluorene, 2-	000053-96-3	NA	NA	NA	NA	NA	NA	NA	NA
Acetylene	000074-86-2	NA	NA	NA	NA	NA	NA	NA	NA
Acrolein	000107-02-8	2.00E-02 [b]	2.00E-05 [b]	NA	NA	NA	NA	NA	NA
Acrylamide	000079-06-1	2.00E-04 [a]	NA	1.30E-04 [a]	4.50E+00 [a]	1.30E-03 [a]	4.50E+00 [b]	8.00E-02 [a]	8.00E-03 [a]
Acrylic Acid	000079-10-7	5.00E-01 [a]	1.00E-03 [a]	NA	NA	NA	NA	NA	NA
Acrylonitrile	000107-13-1	1.00E-03 [b]	2.00E-03 [a]	1.50E-05 [a]	5.40E-01 [a]	6.80E-05 [a]	2.40E-01 [b]	6.00E-01 [a]	1.00E-01 [a]
Acrylyl Chloride	000814-68-6	NA	NA	NA	NA	NA	NA	NA	NA
Adiponitrile	000111-69-3	NA	NA	NA	NA	NA	NA	NA	NA
Aldicarb	000116-06-3	1.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Aldrin	000309-00-2	3.00E-05 [a]	NA	4.90E-04 [a]	1.70E+01 [a]	4.90E-03 [a]	1.70E+01 [b]	2.00E-02 [a]	2.00E-03 [a]
Allyl Alcohol	000107-18-6	5.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Allyl Chloride	000107-05-1	NA	1.00E-03 [a]	NA	NA	NA	NA	NA	NA
Allylamine	000107-11-9	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum	007429-90-5	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum (alkyls)		NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk $(\mu g/L)^{-1}$	Slope Factor $(mg/kg/day)^{-1}$	Unit Risk $(\mu g/m^3)^{-1}$	Slope Factor $(mg/kg/day)^{-1}$	$\mu g/L$ at 10^{-5} Cancer Risk	$\mu g/m^3$ at 10^{-5} Cancer Risk
Aluminum (metal dust, respirable fraction)	007429-90-5	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum (pyro powders)		NA	NA	NA	NA	NA	NA	NA	NA
Aluminum (soluble salts)		NA	NA	NA	NA	NA	NA	NA	NA
Aluminum (welding fume)	007429-90-5	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum Phosphide	020859-73-8	4.00E-04 [a]	NA	NA	NA	NA	NA	NA	NA
Aminobiphenyl, 4-	000092-67-1	NA	NA	NA	NA	NA	NA	NA	NA
Aminopterin	000054-62-6	NA	NA	NA	NA	NA	NA	NA	NA
Amiton	000078-53-5	NA	NA	NA	NA	NA	NA	NA	NA
Amiton Oxalate	003734-97-2	NA	NA	NA	NA	NA	NA	NA	NA
Ammonia	007664-41-7	NA	1.00E-01 [a]	NA	NA	NA	NA	NA	NA
Ammonium Nitrate	006484-52-2	NA	NA	NA	NA	NA	NA	NA	NA
Ammonium Picrate	000131-74-8	NA	NA	NA	NA	NA	NA	NA	NA
Amosite	012172-73-5	NA	NA	NA	NA	NA	NA	NA	NA
Amphetamine	000300-62-9	NA	NA	NA	NA	NA	NA	NA	NA
Aniline	000062-53-3	NA	1.00E-03 [a]	1.60E-07 [a]	5.70E-03 [a]	NA	NA	6.00E+01	NA
Aniline, 2,4,6-Trimethyl-	000088-05-1	NA	NA	NA	NA	NA	NA	NA	NA
Anisidine, o-	000090-04-0	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	000120-12-7	3.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Antimony	007440-36-0	4.00E-04 [a]	NA	NA	NA	NA	NA	NA	NA
Antimony Compounds (as Sb)		4.00E-04 [a]	NA	NA	NA	NA	NA	NA	NA
Antimony Pentafluoride	007783-70-2	NA	NA	NA	NA	NA	NA	NA	NA
Antimycin A	001397-94-0	NA	NA	NA	NA	NA	NA	NA	NA

Revision: 04/06/95

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk (µg/L)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	Unit Risk (µg/m^3)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	µg/L at 10^{-5} Cancer Risk	µg/m^3 at 10^{-5} Cancer Risk
Arsenic	007440-38-2	3.00E-04 [a]	NA	5.00E-05 [a]	NA	4.30E-03 [a]	5.00E+01 [b]	NA	2.00E-03 [a]
Arsenic (Inorganic compounds)		3.00E-04 [a]	NA	5.00E-05 [a]	NA	4.30E-03 [a]	5.00E+01 [b]	NA	2.00E-03 [a]
Arsenic (Organic compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Arsenic Pentoxide	001303-28-2	NA	NA	NA	NA	NA	NA	NA	NA
Arsenous Oxide	001327-53-3	NA	NA	NA	NA	NA	NA	NA	NA
Arsenous Trichloride	007784-34-1	NA	NA	NA	NA	NA	NA	NA	NA
Arsine	007784-42-1	NA	5.00E-05 [a]	NA	NA	NA	NA	NA	NA
Asbestos	001332-21-4	NA	NA	NA	NA	NA	NA	NA	NA
Azinphos-Ethyl	002642-71-9	NA	NA	NA	NA	NA	NA	NA	NA
Azinphos-Methyl	000086-50-0	NA	NA	NA	NA	NA	NA	NA	NA
Barium	007440-39-3	7.00E-02 [a]	5.00E-04 [b,c]	NA	NA	NA	NA	NA	NA
Barium (Soluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Barium Nitrate	010022-31-8	NA	NA	NA	NA	NA	NA	NA	NA
Benzal Chloride	000098-87-3	NA	NA	NA	NA	NA	NA	NA	NA
Benzenamine, 3-(Trifluoromethyl)	000098-16-8	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	000071-43-2	NA	NA	8.30E-07 [a]	2.90E-02 [a]	8.30E-06 [a]	2.90E-02 [b]	1.00E+01 [a]	1.00E+00 [a]
Benzene, 1-(Chloromethyl)-4-nitro-	000100-14-1	NA	NA	NA	NA	NA	NA	NA	NA
Benzenearsonic Acid	000098-05-5	NA	NA	NA	NA	NA	NA	NA	NA
Benzidine	000092-87-5	3.00E-03 [a]	NA	6.70E-03 [a]	2.30E+02 [a]	6.70E-02 [a]	2.30E+02 [a]	2.00E-03 [a]	2.00E-04 [a]
Benzimidazole, 4,5-Dichloro-2-(trifluoromethyl)	003615-21-2	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	000056-55-3	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene (also see Coal Tar Pitch Volatiles)	000050-32-8	NA	NA	2.10E-04 [a]	7.30E+00 [a]	NA	NA	5.00E-02	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk $(\mu g/L)^{-1}$	Oral: Slope Factor $(mg/kg/day)^{-1}$	Inhalation: Unit Risk $(\mu g/m^3)^{-1}$	Inhalation: Slope Factor $(mg/kg/day)^{-1}$	Risk Concentration: µg/L at 10^{-5} Cancer Risk	Risk Concentration: $\mu g/m^3$ at 10^{-5} Cancer Risk
Benzo(b)fluoranthene	000205-99-2	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(c)acridine		NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	000207-08-9	NA	NA	NA	NA	NA	NA	NA	NA
Benzotrichloride	000098-07-7	NA	NA	3.60E-04 [a]	1.30E+01 [a]	NA	NA	3.00E-02	NA
Benzyl Alcohol	000100-51-6	3.00E-01 [b]	NA	NA	NA	NA	NA	NA	NA
Benzyl Chloride	000100-44-7	NA	NA	4.90E-06 [a]	1.70E-01 [a]	NA	NA	2.00E+00	NA
Benzyl Cyanide	000140-29-4	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	007440-41-7	5.00E-03 [a]	NA	1.20E-04 [a]	4.30E+00 [a]	2.40E-03 [a]	8.40E+00 [b]	8.30E-02 [a]	4.00E-03 [a]
Beryllium Compounds (as Be)		5.00E-03 [a]	NA	1.20E-04 [a]	4.30E+00 [a]	2.40E-03 [a]	8.40E+00 [b]	8.30E-02 [a]	4.00E-03 [a]
Bicyclo [2.2.1] Heptane-2-carbonitrile, 5-chlor-6-(((methylamino)carbonyl) oxy)imino)-(1	015271-41-7	NA	NA	NA	NA	NA	NA	NA	NA
Biphenyl (diphenyl)	000092-52-4	5.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Bitoscanate	004044-65-9	NA	NA	NA	NA	NA	NA	NA	NA
Boric Acid	010043-35-3	NA	NA	NA	NA	NA	NA	NA	NA
Boron	007440-42-8	9.00E-02 [a]	2.00E-02 [a]	NA	NA	NA	NA	NA	NA
Boron Trichloride	010294-34-5	NA	NA	NA	NA	NA	NA	NA	NA
Boron Trifluoride	007637-07-2	NA	7.00E-04 [b]	NA	NA	NA	NA	NA	NA
Boron Trifluoride Compound with Methyl Ether (1:1)	000353-42-4	NA	NA	NA	NA	NA	NA	NA	NA
Bromadiolone	028772-56-7	NA	NA	NA	NA	NA	NA	NA	NA
Bromine	007726-95-6	NA	NA	NA	NA	NA	NA	NA	NA
Bromoform	000075-25-2	2.00E-02 [a]	NA	2.30E-07 [a]	7.90E-03 [a]	1.10E-06 [a]	3.90E-03 [b]	4.00E+01 [a]	9.00E+00 [a]
Butadiene, 1,3-	000106-99-0	NA	NA	NA	NA	2.80E-04 [a]	1.80E+00 [b]	NA	4.00E-02 [a]

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk (µg/L)$^{-1}$	Oral: Slope Factor (mg/kg/day)$^{-1}$	Inhalation: Unit Risk (µg/m^3)$^{-1}$	Inhalation: Slope Factor (mg/kg/day)$^{-1}$	Risk Concentration: µg/L at 10^{-5} Cancer Risk	Risk Concentration: µg/m^3 at 10^{-5} Cancer Risk
Butane, i-		NA	NA	NA	NA	NA	NA	NA	NA
Butane, n-	000106-97-8	NA	NA	NA	NA	NA	NA	NA	NA
Butene, 1-	000106-98-9	NA	NA	NA	NA	NA	NA	NA	NA
Butene, cis-2-	000590-18-1	NA	NA	NA	NA	NA	NA	NA	NA
Butene, i-		NA	NA	NA	NA	NA	NA	NA	NA
Butene, trans-2-	000624-64-6	NA	NA	NA	NA	NA	NA	NA	NA
Butyl benzyl phthalate	000085-68-7	2.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Butylbenzene, sec-	000135-98-8	NA	NA	NA	NA	NA	NA	NA	NA
Butylphenol, 2,2-Methylene bis(4-methyl) 6-t-butylphen-		NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	007440-43-9	5.00E-04 [a,f]	NA	NA	NA	1.80E-03 [a]	6.10E+00 [b]	NA	6.00E-03 [a]
Cadmium (dust)	007440-43-9	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium (dusts and salts)		NA	NA	NA	NA	NA	NA	NA	NA
Cadmium (fume)	007440-43-9	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium Compounds (as Cd)		5.00E-04 [a,f]	NA	NA	NA	1.80E-03 [a]	6.10E+00	NA	6.00E-03 [a]
Cadmium Oxide	001306-19-0	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium Stearate	002223-93-0	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	007440-70-2	NA	NA	NA	NA	NA	NA	NA	NA
Calcium Arsenate	007778-44-1	NA	NA	NA	NA	NA	NA	NA	NA
Calcium Cyanamide	000156-62-7	NA	NA	NA	NA	NA	NA	NA	NA
Calcium Stearate	001592-23-0	NA	NA	NA	NA	NA	NA	NA	NA
Camphechlor	008001-35-2	NA	NA	3.20E-05 [a]	1.10E+00 [a]	3.20E-04 [a]	1.10E+00 [b]	3.00E-01 [a]	3.00E-02 [a]

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk (µg/L)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	Unit Risk (µg/m^3)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	µg/L at 10^{-5} Cancer Risk	µg/m^3 at 10^{-5} Cancer Risk
Cantharidin	000056-25-7	NA	NA	NA	NA	NA	NA	NA	NA
Caprolactam (dust)	000105-60-2	5.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Captan	000133-06-2	1.30E-01 [a]	NA	1.00E-07 [b]	3.50E-03 [b]	NA	NA	NA	NA
Carbachol Chloride	000051-83-2	NA	NA	NA	NA	NA	NA	NA	NA
Carbamic Acid, Methyl, O-(((2,4-dimethyl-1, 3-dithiolan-2-yl) methylene)amino)-	026419-73-8	NA	NA	NA	NA	NA	NA	NA	NA
Carbaryl	000063-25-2	1.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Carbofuran	001563-66-2	5.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Carbon Disulfide	000075-15-0	1.00E-01 [a]	1.00E-02 [a]	NA	NA	NA	NA	NA	NA
Carbon Monoxide	000630-08-0	NA	NA	NA	NA	NA	NA	NA	NA
Carbon Tetrachloride	000056-23-5	7.00E-04 [a]	NA	3.70E-06 [a]	1.30E-01 [a]	1.50E-05 [a]	5.30E-02 [b]	3.00E+~~01~~ +00 [a]	7.00E-01 [a]
Carbonyl Sulfide	000463-58-1	NA	NA	NA	NA	NA	NA	NA	NA
Carbophenothion	000786-19-6	NA	NA	NA	NA	NA	NA	NA	NA
Carene, delta-3-	020296-50-8	NA	NA	NA	NA	NA	NA	NA	NA
Catechol	000120-80-9	NA	NA	NA	NA	NA	NA	NA	NA
Chloracetic Acid	000079-11-8	2.00E-03 [b]	NA	NA	NA	NA	NA	NA	NA
Chloramben	000133-90-4	1.50E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Chlordane	000057-74-9	6.00E-05 [a]	NA	3.70E-05 [a]	1.30E+00 [a]	3.70E-04 [a]	1.30E+00 [b]	3.00E-01 [a]	3.00E-02 [a]
Chlorfenvinfos	000470-90-6	NA	NA	NA	NA	NA	NA	NA	NA
Chlorine	007782-50-5	1.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Chlormephos	024934-91-6	NA	NA	NA	NA	NA	NA	NA	NA
Chlormequat Chloride	000999-81-5	NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic Oral RfD (mg/kg/day)	Chronic Inhalation RfC (mg/m^3)	Oral Unit Risk $(\mu g/L)^{-1}$	Oral Slope Factor $(mg/kg/day)^{-1}$	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Inhalation Slope Factor $(mg/kg/day)^{-1}$	Risk Concentration $\mu g/L$ at 10^{-5} Cancer Risk	Risk Concentration $\mu g/m^3$ at 10^{-5} Cancer Risk
Chloroacetophenone, 2-	000532-27-4	NA	3.00E-05	NA	NA	NA	NA	NA	NA
Chlorobenzene	000108-90-7	2.00E-02 [a]	2.00E-02 [a]	NA	NA	NA	NA	NA	NA
Chlorobenzilate	000510-15-6	2.00E-02 [a]	NA	7.80E-06 [b]	2.70E-01 [b]	7.80E-06 [b]	2.70E-01 [b]	NA	NA
Chloroethanol	000107-07-3	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethyl Chloroformate	000627-11-2	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	000067-66-3	1.00E-02 [a]	NA	1.70E-07 [a]	6.10E-03 [a]	2.30E-05 [a]	8.10E-02 [b]	6.00E+01 [a]	4.00E-01 [a]
Chloromethyl Ether	000542-88-1	NA	NA	6.20E-03 [a]	2.20E+02 [a]	6.20E-02 [a]	2.20E+02 [b]	1.60E-03 [a]	1.60E-04 [a]
Chloromethyl Methyl Ether	000107-30-2	NA	NA	NA	NA	NA	NA	NA	NA
Chlorophacinone	003691-35-8	NA	NA	NA	NA	NA	NA	NA	NA
Chloroprene	000126-99-8	2.00E-02 [b]	7.00E-03 [b]	NA	NA	NA	NA	NA	NA
Chloropropane, 1,2-dibromo-3-	000096-12-8	NA	2.00E-04 [a]	4.00E-05 [b]	1.40E+00 [b]	6.90E-07 [b]	2.40E-03 [b]	NA	NA
Chlorothiophos	021923-23-9	NA	NA	NA	NA	NA	NA	NA	NA
Chloroxuron	001982-47-4	NA	NA	NA	NA	NA	NA	NA	NA
Chromic Chloride	010025-73-7	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	007440-47-3	NA	NA	NA	NA	NA	NA	NA	NA
Chromium Compounds (As Cr) (does not include Cr VI cmpds)		NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	000218-01-9	NA	NA	NA	NA	NA	NA	NA	NA
Chrysotile	012001-29-5	NA	NA	NA	NA	NA	NA	NA	NA
Coal Tar Pitch Volatiles (as benzene solubles)	065996-93-2	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt Carbonyl	010210-68-1	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt Compounds		NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk $(\mu g/L)^{-1}$	Oral: Slope Factor $(mg/kg/day)^{-1}$	Inhalation: Unit Risk $(\mu g/m^3)^{-1}$	Inhalation: Slope Factor $(mg/kg/day)^{-1}$	Risk Concentration: µg/L at 10^{-5} Cancer Risk	Risk Concentration: $\mu g/m^3$ at 10^{-5} Cancer Risk
Cobalt, ((2,2-(1,2-Ethanediylbis (nitrilo-methylidyne))Bis (6-fluorophenolato))(2-)-NNOO)	062207-76-5	NA	NA	NA	NA	NA	NA	NA	NA
Coke Oven Emissions		NA	NA	NA	NA	NA	NA	NA	NA
Colchicine	000064-86-8	NA	NA	NA	NA	NA	NA	NA	NA
Copper	007440-50-8	NA [j]	NA	NA	NA	NA	NA	NA	NA
Copper (dusts and mists)	007440-50-8	NA [j]	NA	NA	NA	NA	NA	NA	NA
Copper (fume)	007440-50-8	NA [j]	NA	NA	NA	NA	NA	NA	NA
Coumaphos	000056-72-4	NA	NA	NA	NA	NA	NA	NA	NA
Coumatetralyl	005836-29-3	NA	NA	NA	NA	NA	NA	NA	NA
Cresols/Cresylic Acid (isomers and mixture) (cresol)	001319-77-3	NA	NA	NA	NA	NA	NA	NA	NA
Cresols/Cresylic Acid (isomers and mixture) (m-cresol)	000108-39-4	5.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Cresols/Cresylic Acid (isomers and mixture) (o-cresol)	000095-48-7	5.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Cresols/Cresylic Acid (isomers and mixture) (p-cresol)	000106-44-5	5.00E-03 [b]	NA	NA	NA	NA	NA	NA	NA
Crimidine	000535-89-7	NA	NA	NA	NA	NA	NA	NA	NA
Crocidolite	012001-28-4	NA	NA	NA	NA	NA	NA	NA	NA
Crotonaldehyde	004170-30-3	NA	NA	NA	NA	NA	NA	NA	NA
Crotonaldehyde, (E)-	000123-73-9	NA	NA	5.40E-05 [b]	1.90E+00 [b]	NA	NA	NA	NA
Cumene (Isopropylbenzene)	000098-82-8	4.00E-02 [a]	9.00E-03 [a]	NA	NA	NA	NA	NA	NA
Cyanide Compounds (as free cyanide)		2.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Cyanogen Bromide	000506-68-3	9.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Cyanogen Iodide	000506-78-5	NA	NA	NA	NA	NA	NA	NA	NA
Cyanophos	002636-26-2	NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk (µg/L)$^{-1}$	Oral: Slope Factor (mg/kg/day)$^{-1}$	Inhalation: Unit Risk (µg/m^3)$^{-1}$	Inhalation: Slope Factor (mg/kg/day)$^{-1}$	Risk Concentration: µg/L at 10^{-5} Cancer Risk	Risk Concentration: µg/m^3 at 10^{-5} Cancer Risk
Cyanuric Fluoride	000675-14-9	NA	NA	NA	NA	NA	NA	NA	NA
Cycloheximide	000066-81-9	NA	NA	NA	NA	NA	NA	NA	NA
Cyclohexylamine	000108-91-8	2.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Cyclopentane	000287-92-3	NA	NA	NA	NA	NA	NA	NA	NA
Cyclopentene	000142-29-0	NA	NA	NA	NA	NA	NA	NA	NA
DDE	003547-04-4	NA	NA	NA	NA	NA	NA	NA	NA
DEHP (Bis(2-ethylhexyl)phthalate)	000117-81-7	2.00E-02 [a]	NA	4.00E-07 [a]	1.40E-02 [a]	NA	NA	3.00E+01	NA
Decaborane (14)	017702-41-9	NA	NA	NA	NA	NA	NA	NA	NA
Demeton	008065-48-3	4.00E-05 [a]	NA	NA	NA	NA	NA	NA	NA
Demeton-S-Methyl	000919-86-8	NA	NA	NA	NA	NA	NA	NA	NA
Dialifor	010311-84-9	NA	NA	NA	NA	NA	NA	NA	NA
Diazomethane	000334-88-3	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	000053-70-3	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	000132-64-9	NA	NA	NA	NA	NA	NA	NA	NA
Diborane	019287-45-7	NA	NA	NA	NA	NA	NA	NA	NA
Dibutylphthalate	000084-74-2	1.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Dichlorobenzene, 1,4- (p)	000106-46-7	NA	8.00E-01 [a]	6.80E-07 [b]	2.40E-02 [b]	NA	NA	NA	NA
Dichlorobenzidine, 3,3'-	000091-94-1	NA	NA	1.30E-05 [a]	4.50E-01 [a]	NA	NA	8.00E-01	NA
Dichlorobutene, Trans-1,4-	000110-57-6	NA	NA	NA	NA	NA	NA	NA	NA
Dichloroethyl Ether (Bis(2-chloroethyl)ether)	000111-44-4	NA	NA	3.30E-05 [a]	1.10E+00 [a]	3.30E-04 [a]	1.10E+00 [b]	3.00E-01 [a]	3.00E-02 [a]
Dichloromethylphenylsilane	000149-74-6	NA	NA	NA	NA	NA	NA	NA	NA
Dichlorophenoxyacetic Acid, 2,4- (2,4-D) salts and	000094-75-7	1.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk (μg/L)$^{-1}$	Oral: Slope Factor (mg/kg/day)$^{-1}$	Inhalation: Unit Risk (μg/m^3)$^{-1}$	Inhalation: Slope Factor (mg/kg/day)$^{-1}$	Risk Concentration: μg/L at 10^{-5} Cancer Risk	Risk Concentration: μg/m^3 at 10^{-5} Cancer Risk
esters									
Dichloropropene, 1,3-	000542-75-6	3.00E-04 [a]	2.00E-02 [a]	5.00E-06 [b]	1.80E-01 [b]	3.70E-05 [b]	1.30E-01 [b]	NA	NA
Dichlorvos (DDVP)	000062-73-7	5.00E-04 [a]	5.00E-04 [a]	8.30E-06 [a]	2.90E-01 [a]	NA	NA	1.00E+00	NA
Dicrotophos (Bidrin)	000141-66-2	1.00E-04 [a]	NA	NA	NA	NA	NA	NA	NA
Diepoxide		NA	NA	NA	NA	NA	NA	NA	NA
Diepoxybutane	001464-53-5	NA	NA	NA	NA	NA	NA	NA	NA
Diethanolamine	000111-42-2	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl Chlorophospate	000814-49-3	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl Phthalate	000084-66-2	8.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Diethyl Sulfate	000064-67-5	NA	NA	NA	NA	NA	NA	NA	NA
Diethylcarbamazine Citrate	001642-54-2	NA	NA	NA	NA	NA	NA	NA	NA
Diethylenetriamine	000111-40-0	NA	NA	NA	NA	NA	NA	NA	NA
Diethylhexylsebacate		NA	NA	NA	NA	NA	NA	NA	NA
Digitoxin	000071-63-6	NA	NA	NA	NA	NA	NA	NA	NA
Diglycidyl Ether	002238-07-5	NA	NA	NA	NA	NA	NA	NA	NA
Digoxin	020830-75-5	NA	NA	NA	NA	NA	NA	NA	NA
Diisopropylmethylphosphonate	001445-75-6	8.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Dimefox	000115-26-4	NA	NA	NA	NA	NA	NA	NA	NA
Dimethoate	000060-51-5	2.00E-04 [a]	NA	NA	NA	NA	NA	NA	NA
Dimethoxybenzidine, 3,3'-	000119-90-4	NA	NA	4.00E-07 [b]	1.40E-02 [b]	NA	NA	NA	NA
Dimethyl Aminoazobenzene	000060-11-7	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Carbamoyl Chloride	000079-44-7	NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk $(\mu g/L)^{-1}$	Slope Factor $(mg/kg/day)^{-1}$	Unit Risk $(\mu g/m^3)^{-1}$	Slope Factor $(mg/kg/day)^{-1}$	$\mu g/L$ at 10^{-5} Cancer Risk	$\mu g/m^3$ at 10^{-5} Cancer Risk
Dimethyl Formamide	000068-12-2	1.00E-01 [b]	3.00E-02 [b]	NA	NA	NA	NA	NA	NA
Dimethyl Phosphorochloridothioate	002524-03-0	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Phthalate	000131-11-3	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Sulfate	000077-78-1	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl-p-Phenylenediamine	000099-98-9	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylaniline (N,N-Dimethylaniline)	000121-69-7	2.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Dimethylbenzidine, 3,3'-	000119-93-7	NA	NA	2.60E-04 [b]	9.20E+00 [b]	NA	NA	NA	NA
Dimethylbutane, 2,2-	000075-83-2	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylbutane, 2,3-	000079-29-8	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyldichlorosilane	000075-78-5	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylhexane, 2,3-		NA	NA	NA	NA	NA	NA	NA	NA
Dimethylhexane, 2,4-		NA	NA	NA	NA	NA	NA	NA	NA
Dimethylhydrazine	000057-14-7	NA	NA	NA [b]	NA [b]	NA [b]	NA [b]	NA	NA
Dimethylpentane, 2,4-	000108-08-7	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylphenethylamine, alpha, alpha-		NA	NA	NA	NA	NA	NA	NA	NA
Dimetilan	000644-64-4	NA	NA	NA	NA	NA	NA	NA	NA
Dinitro-o-cresol, 4,6- and salts	000534-52-1	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrobenzene, 1,3-	000099-65-0	1.00E-04 [a]	NA	NA	NA	NA	NA	NA	NA
Dinitrobenzenes (all isomers)	025154-54-5	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrocresol	000534-52-1	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrophenol, 2,4-	000051-28-5	2.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Dinitropyrene, 1,6-	042397-64-8	NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk (µg/L)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	Unit Risk (µg/m^3)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	µg/L at 10^{-5} Cancer Risk	µg/m^3 at 10^{-5} Cancer Risk
Dinitrotoluene	025321-14-6	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrotoluene, 2,4-	000121-14-2	2.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Dinitrotoluene, 2,6-	000606-20-2	1.00E-03 [b]	NA	NA	NA	NA	NA	NA	NA
Dinitrotoluene, Mixture		NA	NA	1.90E-05 [a]	6.80E-01 [a]	NA	NA	5.00E-01 [a]	NA
Dinoseb	000088-85-7	1.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Dinoterb	001420-07-1	NA	NA	NA	NA	NA	NA	NA	NA
Dioctyl Sebacate	000122-62-3	NA	NA	NA	NA	NA	NA	NA	NA
Dioxane, 1,4- (1,4-Diethyleneoxide)	000123-91-1	NA	NA	3.10E-07 [a]	1.10E-02 [a]	NA	NA	3.00E+01	NA
Dioxathion	000078-34-2	NA	NA	NA	NA	NA	NA	NA	NA
Diphacinone	000082-66-6	NA	NA	NA	NA	NA	NA	NA	NA
Diphenylamine	000122-39-4	2.50E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Diphenylhydrazine, 1,2-	000122-66-7	NA	NA	2.20E-05 [a]	8.00E-01 [a]	2.20E-04 [a]	8.00E-01 [b]	5.00E-01	5.00E-02 [a]
Diphenyloxazole, 2,5-	000092-71-7	NA	NA	NA	NA	NA	NA	NA	NA
Diphosphoramide, Octamethyl-	000152-16-9	2.00E-03 [b]	NA	NA	NA	NA	NA	NA	NA
Disulfoton	000298-04-4	4.00E-05 [a]	NA	NA	NA	NA	NA	NA	NA
Dithiazanine Iodide	000514-73-8	NA	NA	NA	NA	NA	NA	NA	NA
Dithiobiuret	000541-53-7	NA	NA	NA	NA	NA	NA	NA	NA
EPN	002104-64-5	1.00E-05 [a]	NA	NA	NA	NA	NA	NA	NA
Emetine, Dihydrochloride	000316-42-7	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan	000115-29-7	6.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Endothion	002778-04-3	NA	NA	NA	NA	NA	NA	NA	NA
Endrin	000072-20-8	3.00E-04 [a]	NA	NA	NA	NA	NA	NA	NA

Revision: 04/06/95

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk (μg/L)$^{-1}$	Oral: Slope Factor (mg/kg/day)$^{-1}$	Inhalation: Unit Risk (μg/m^3)$^{-1}$	Inhalation: Slope Factor (mg/kg/day)$^{-1}$	Risk Concentration: μg/L at 10^{-5} Cancer Risk	Risk Concentration: μg/m^3 at 10^{-5} Cancer Risk
Epichlorohydrin	000106-89-8	2.00E-03 [b]	1.00E-03 [b]	2.80E-07 [a]	9.90E-03 [a]	1.20E-06 [a]	4.20E-03 [b]	3.00E+01 [a]	8.00E+00 [a]
Epoxybutane, 1,2-	000106-88-7	NA	2.00E-02 [a]	NA	NA	NA	NA	NA	NA
Ergocalciferol	000050-14-6	NA	NA	NA	NA	NA	NA	NA	NA
Ergotamine Tartrate	000379-79-3	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	000074-84-0	NA	NA	NA	NA	NA	NA	NA	NA
Ethanesulfonyl Chloride, 2-Chloro	001622-32-8	NA	NA	NA	NA	NA	NA	NA	NA
Ethanol, 1,2-Dichloro-, Acetate	010140-87-1	NA	NA	NA	NA	NA	NA	NA	NA
Ethion	000563-12-2	5.00E-04 [a]	NA	NA	NA	NA	NA	NA	NA
Ethoprophos	013194-48-4	NA	NA	NA	NA	NA	NA	NA	NA
Ethybis(2-Chloroethyl)amine	000538-07-8	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Acrylate	000140-88-5	NA	NA	1.40E-06 [b]	4.80E-02 [b]	NA	NA	NA	NA
Ethyl Benzene	000100-41-4	1.00E-01 [a]	1.00E+00 [a]	NA	NA	NA	NA	NA	NA
Ethyl Carbamate (Urethane)	000051-79-6	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Chloride (Chloroethane)	000075-00-3	NA	1.00E+01 [a]	NA	NA	NA	NA	NA	NA
Ethylcyclohexane	001678-91-7	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene	000074-85-1	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene Dibromide (Dibromoethane)	000106-93-4	NA	2.00E-04 [b]	2.50E-03 [a]	8.50E+01 [a]	2.20E-04 [a]	7.60E-01 [a]	4.00E-03 [a]	5.00E-02 [a]
Ethylene Dichloride (1,2-Dichloroethane)	000107-06-2	NA	NA	2.60E-06 [a]	9.10E-02 [a]	2.60E-05 [a]	9.10E-02 [b]	4.00E+00 [a]	4.00E-01 [a]
Ethylene Fluorohydrin	000371-62-0	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene Glycol	000107-21-1	2.00E+00 [a]	NA	NA	NA	NA	NA	NA	NA
Ethylene Oxide	000075-21-8	NA	NA	2.90E-05 [b]	1.02E+00 [b]	1.00E-04 [b]	3.50E-01 [b]	NA	NA
Ethylene Thiourea	000096-45-7	8.00E-05 [a]	NA	3.40E-06 [b]	1.10E-01 [b]	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk (µg/L)$^{-1}$	Oral: Slope Factor (mg/kg/day)$^{-1}$	Inhalation: Unit Risk (µg/m^3)$^{-1}$	Inhalation: Slope Factor (mg/kg/day)$^{-1}$	Risk Concentration: µg/L at 10^{-5} Cancer Risk	Risk Concentration: µg/m^3 at 10^{-5} Cancer Risk
Ethylenediamine	000107-15-3	2.00E-02 [b]	NA	NA	NA	NA	NA	NA	NA
Ethyleneimine	000151-56-4	NA	NA	NA	NA	NA	NA	NA	NA
Ethylhexane, 3-	000619-99-8	NA	NA	NA	NA	NA	NA	NA	NA
Ethylidene Dichloride (1,1-Dichloroethane)	000075-34-3	1.00E-01 [b]	5.00E-01 [b]	NA	NA	NA	NA	NA	NA
Ethylthiocyanate	000542-90-5	NA	NA	NA	NA	NA	NA	NA	NA
Ethyltoluene, 1-		NA	NA	NA	NA	NA	NA	NA	NA
Ethyltoluene, 2-	000611-14-3	NA	NA	NA	NA	NA	NA	NA	NA
Ethyltoluene, 3-	000620-14-4	NA	NA	NA	NA	NA	NA	NA	NA
Fenamiphos	022224-92-6	2.50E-04 [a]	NA	NA	NA	NA	NA	NA	NA
Fenitrothion	000122-14-5	NA	NA	NA	NA	NA	NA	NA	NA
Fensulfothion	000115-90-2	NA	NA	NA	NA	NA	NA	NA	NA
Fluenetil	004301-50-2	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	000206-44-0	4.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Fluorene	000086-73-7	4.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Fluorine	007782-41-4	6.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Fluoroacetamide	000640-19-7	NA	NA	NA	NA	NA	NA	NA	NA
Fluoroacetic Acid	000144-49-0	NA	NA	NA	NA	NA	NA	NA	NA
Fluoroacetyl Chloride	000359-06-8	NA	NA	NA	NA	NA	NA	NA	NA
Fluorouracil	000051-21-8	NA	NA	NA	NA	NA	NA	NA	NA
Fonofos	000944-22-9	2.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Formaldehyde	000050-00-0	2.00E-01 [a]	NA	NA	NA	1.30E-05 [a]	4.50E-02 [b]	NA	8.00E-01 [a]
Formaldehyde Cyanohydrin	000107-16-4	NA	NA	NA	NA	NA	NA	NA	NA

Revision: 04/06/95

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk (µg/L)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	Unit Risk (µg/m^3)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	µg/L at 10^{-5} Cancer Risk	µg/m^3 at 10^{-5} Cancer Risk
Formetanate Hydrochloride	023422-53-9	NA	NA	NA	NA	NA	NA	NA	NA
Formothion	002540-82-1	NA	NA	NA	NA	NA	NA	NA	NA
Formparanate	017702-57-7	NA	NA	NA	NA	NA	NA	NA	NA
Fosthietan	021548-32-3	NA	NA	NA	NA	NA	NA	NA	NA
Fuberidazole	003878-19-1	NA	NA	NA	NA	NA	NA	NA	NA
Furan	000110-00-9	1.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Gallium	007440-55-3	NA	NA	NA	NA	NA	NA	NA	NA
Gallium Trichloride	013450-90-3	NA	NA	NA	NA	NA	NA	NA	NA
Germanium	007440-56-4	NA	NA	NA	NA	NA	NA	NA	NA
Glycol Ethers		NA	NA	NA	NA	NA	NA	NA	NA
HMX (Cyclotetramethylene Tetranitramine)	002691-41-0	5.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Heptachlor	000076-44-8	5.00E-04 [a]	NA	1.30E-04 [a]	4.50E+00 [a]	1.30E-03 [a]	4.50E+00 [b]	8.00E-02 [a]	8.00E-03 [a]
Heptane, n-	000142-82-5	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	000118-74-1	8.00E-04 [a]	NA	4.60E-05 [a]	1.60E+00 [a]	4.60E-04 [a]	1.60E+00 [b]	2.00E-01 [a]	2.00E-02 [a]
Hexachlorobutadiene	000087-68-3	NA	NA	2.20E-06 [a]	7.80E-02 [a]	2.20E-05 [a]	7.80E-02 [b]	5.00E-00 [a]	5.00E-01 [a]
Hexachlorocyclopentadiene	000077-47-4	7.00E-03 [a]	7.00E-05 [a]	NA	NA	NA	NA	NA	NA
Hexachloroethane	000067-72-1	1.00E-03 [a]	NA	4.00E-07 [a]	1.40E-02 [a]	4.00E-06 [a]	1.40E-02 [b]	3.00E+01 [a]	3.00E+00 [a]
Hexamethylene-1,6-diisocyanate	000822-06-0	NA	1.00E-05 [a]	NA	NA	NA	NA	NA	NA
Hexamethylenediamine, N,N-dibutyl-	004835-11-4	NA	NA	NA	NA	NA	NA	NA	NA
Hexamethylphosphoramide	000680-31-9	NA	NA	NA	NA	NA	NA	NA	NA
Hexane, n-	000110-54-3	6.00E-02 [b]	2.00E-01 [b]	NA	NA	NA	NA	NA	NA
Hexene, 1-	000592-41-6	NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk (μg/L)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	Unit Risk (μg/m^3)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	μg/L at 10^{-5} Cancer Risk	μg/m^3 at 10^{-5} Cancer Risk
Hexene, cis-2-		NA	NA	NA	NA	NA	NA	NA	NA
Hexene, trans-2-	004050-45-7	NA	NA	NA	NA	NA	NA	NA	NA
Hydrazine	000302-01-2	NA	NA	8.50E-05 [a]	3.00E+00 [a]	4.90E-03 [a]	1.70E+01 [b]	1.00E-01 [a]	2.00E-03 [a]
Hydrochloric Acid or (Hydrogen chloride)	007647-01-0	NA	7.00E-03 [a]	NA	NA	NA	NA	NA	NA
Hydrocyanic Acid or (Hydrogen cyanide)	000074-90-8	2.00E-02 [a]	3.00E-03 [a]	NA	NA	NA	NA	NA	NA
Hydrogen Chloride, Anhydrous	007647-01-0	NA	7.00E-03 [a]	NA	NA	NA	NA	NA	NA
Hydrogen Fluoride (Hydrofluoric acid)	007664-39-3	NA	NA	NA	NA	NA	NA	NA	NA
Hydrogen Peroxide (saturated)	007722-84-1	NA	NA	NA	NA	NA	NA	NA	NA
Hydrogen Selenide	007783-07-5	NA	NA	NA	NA	NA	NA	NA	NA
Hydrogen Sulfide	007783-06-4	3.00E-03 [a]	9.00E-04 [a]	NA	NA	NA	NA	NA	NA
Hydroquinone	000123-31-9	4.00E-02 [b]	NA	NA	NA	NA	NA	NA	NA
Iodine	007553-56-2	NA	NA	NA	NA	NA	NA	NA	NA
Iron	007439-89-6	NA	NA	NA	NA	NA	NA	NA	NA
Iron (soluble salts)		NA	NA	NA	NA	NA	NA	NA	NA
Iron, Pentacarbonyl-	013463-40-6	NA	NA	NA	NA	NA	NA	NA	NA
Isobenzan	000297-78-9	NA	NA	NA	NA	NA	NA	NA	NA
Isobutyronitrile	000078-82-0	NA	NA	NA	NA	NA	NA	NA	NA
Isocyanic Acid, 3,4-Dichlorophenyl Ester	000102-36-3	NA	NA	NA	NA	NA	NA	NA	NA
Isodrin	000465-73-6	NA	NA	NA	NA	NA	NA	NA	NA
Isofluorphate	000055-91-4	NA	NA	NA	NA	NA	NA	NA	NA
Isophorone	000078-59-1	2.00E-01 [a]	NA	2.70E-08 [a]	9.50E-04 [a]	NA	NA	4.00E+02	NA
Isophorone Diisocyanate	004098-71-9	NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk (µg/L)$^{-1}$	Oral: Slope Factor (mg/kg/day)$^{-1}$	Inhalation: Unit Risk (µg/m^3)$^{-1}$	Inhalation: Slope Factor (mg/kg/day)$^{-1}$	Risk Concentration: µg/L at 10^{-5} Cancer Risk	Risk Concentration: µg/m^3 at 10^{-5} Cancer Risk
Isoprene	000078-79-5	NA	NA	NA	NA	NA	NA	NA	NA
Isopropyl Chloroformate	000108-23-6	NA	NA	NA	NA	NA	NA	NA	NA
Isopropymethylpyrazolyl Dimethylcarbamate	000119-38-0	NA	NA	NA	NA	NA	NA	NA	NA
Ketone, Bis(Chloromethyl)	000534-07-6	NA	NA	NA	NA	NA	NA	NA	NA
Lactonitrile	000078-97-7	NA	NA	NA	NA	NA	NA	NA	NA
Lead (Inorganic dusts and fume)		NA	NA	NA	NA	NA	NA	NA	NA
Lead (inorganic)	007439-92-1	NA	NA	NA	NA	NA	NA	NA	NA
Lead (metal)	007439-92-1	NA	NA	NA	NA	NA	NA	NA	NA
Lead Azide	013424-46-9	NA	NA	NA	NA	NA	NA	NA	NA
Lead Compounds (as Pb)		NA	NA	NA	NA	NA	NA	NA	NA
Lead Styphnate	015245-44-0	NA	NA	NA	NA	NA	NA	NA	NA
Lead, Tetraethyl	000078-00-2	NA [d]	NA	NA	NA	NA	NA	NA	NA
Lead, Tetramethyl	000075-74-1	NA [d]	NA	NA	NA	NA	NA	NA	NA
Leptophos	021609-90-5	NA	NA	NA	NA	NA	NA	NA	NA
Lewisite	000541-25-3	NA	NA	NA	NA	NA	NA	NA	NA
Limonene, delta-	005989-27-5	NA	NA	NA	NA	NA	NA	NA	NA
Lindane	000058-89-9	3.00E-04 [a]	NA	3.70E-05 [b]	1.30E+00 [b]	NA	NA	NA	NA
Lithium Hydride	007580-67-8	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	007439-95-4	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium Oxide (fume)	001309-48-4	NA	NA	NA	NA	NA	NA	NA	NA
Maleic Anhydride	000108-31-6	1.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Malononitrile	000109-77-3	2.00E-05 [b]	NA	NA	NA	NA	NA	NA	NA

Revision: 04/06/95

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk (µg/L)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	Unit Risk (µg/m^3)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	µg/L at 10^{-5} Cancer Risk	µg/m^3 at 10^{-5} Cancer Risk
Manganese	007439-96-5	5.00E-03 [a,e]	5.00E-05 [a]	NA	NA	NA	NA	NA	NA
Manganese (Dust and compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Manganese (fume)	007439-96-5	NA	NA	NA	NA	NA	NA	NA	NA
Manganese Compounds (as Mn)		5.00E-03 [a,e]	5.00E-05 [a]	NA	NA	NA	NA	NA	NA
Manganese, Tricarbonyl Methylcyclopentadienyl	012108-13-3	NA	NA	NA	NA	NA	NA	NA	NA
Mechlorethamine	000051-75-2	NA	NA	NA	NA	NA	NA	NA	NA
Mephosfolan	000950-10-7	9.00E-05 [b]	NA	NA	NA	NA	NA	NA	NA
Mercuric Acetate	001600-27-7	NA	NA	NA	NA	NA	NA	NA	NA
Mercuric Chloride	007487-94-7	NA	NA	NA	NA	NA	NA	NA	NA
Mercuric Oxide	021908-53-2	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	007439-97-6	NA	NA	NA	NA	NA	NA	NA	NA
Mercury (Alkyl compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Mercury (Aryl & Inorganic compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Mercury (Inorganic)		3.00E-04 [b]	3.00E-04 [b]	NA	NA	NA	NA [b]	NA	NA
Mercury (vapor)	007439-97-6	NA	3.00E-04 [b]	NA	NA	NA	NA	NA	NA
Mercury Fulminate	000628-86-4	NA	NA	NA	NA	NA	NA	NA	NA
Methacrolein Diacetate	010476-95-6	NA	NA	NA	NA	NA	NA	NA	NA
Methacrylic Anhydride	000760-93-0	NA	NA	NA	NA	NA	NA	NA	NA
Methacrylonitrile	000126-98-7	1.00E-04 [a]	7.00E-04 [a]	NA	NA	NA	NA	NA	NA
Methacryloyl Chloride	000920-46-7	NA	NA	NA	NA	NA	NA	NA	NA
Methacryloyloxyethyl Isocyanate	030674-80-7	NA	NA	NA	NA	NA	NA	NA	NA
Methamidophos	010265-92-6	5.00E-05 [a]	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk (µg/L)$^{-1}$	Oral: Slope Factor (mg/kg/day)$^{-1}$	Inhalation: Unit Risk (µg/m^3)$^{-1}$	Inhalation: Slope Factor (mg/kg/day)$^{-1}$	Risk Concentration: µg/L at 10^{-5} Cancer Risk	Risk Concentration: µg/m^3 at 10^{-5} Cancer Risk
Methane	000074-82-8	NA	NA	NA	NA	NA	NA	NA	NA
Methanesulfonyl Fluoride	000558-25-8	NA	NA	NA	NA	NA	NA	NA	NA
Methanol	000067-56-1	5.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Methidathion	000950-37-8	1.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Methiocarb	002032-65-7	NA	NA	NA	NA	NA	NA	NA	NA
Methicarb	001129-41-5	NA	NA	NA	NA	NA	NA	NA	NA
Methomyl	016752-77-5	2.50E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Methoxychlor	000072-43-5	5.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Methoxyethylmercuric Acetate	000151-38-2	NA	NA	NA	NA	NA	NA	NA	NA
Methyl 2-Chloroacrylate	000080-63-7	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Bromide (Bromomethane)	000074-83-9	1.40E-03 [a]	5.00E-03 [a]	NA	NA	NA	NA	NA	NA
Methyl Chloride (Chloromethane)	000074-87-3	NA	NA	3.70E-07 [b]	1.30E-02 [b]	1.80E-06 [b]	6.30E-03 [b]	NA	NA
Methyl Chloroformate	000079-22-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Ethyl Ketone (2-Butanone)	000078-93-3	6.00E-01 [a]	1.00E+00 [a]	NA	NA	NA	NA	NA	NA
Methyl Hydrazine	000060-34-4	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Iodide (Iodomethane)	000074-88-4	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone (Hexone)	000108-10-1	5.00E-02 [b]	8.00E-02 [b]	NA	NA	NA	NA	NA	NA
Methyl Isocyanate	000624-83-9	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isothiocyanate	000556-61-6	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Mercaptan	000074-93-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Methacrylate	000080-62-6	8.00E-02 [b]	NA	NA	NA	NA	NA	NA	NA
Methyl Phenkapton	003735-23-7	NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk $(\mu g/L)^{-1}$	Oral: Slope Factor $(mg/kg/day)^{-1}$	Inhalation: Unit Risk $(\mu g/m^3)^{-1}$	Inhalation: Slope Factor $(mg/kg/day)^{-1}$	Risk Concentration: µg/L at 10^{-5} Cancer Risk	Risk Concentration: $\mu g/m^3$ at 10^{-5} Cancer Risk
Methyl Phosphonic Dichloride	000676-97-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Tert Butyl Ether	001634-04-4	NA	3.00E+00 b	NA	NA	NA	NA	NA	NA
Methyl Thiocyanate	000556-64-9	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Vinyl Ketone	000078-94-4	NA	NA	NA	NA	NA	NA	NA	NA
Methyl chloroform (1,1,1-Trichloroethane)	000071-55-6	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-1-Butene, 2-	000563-46-2	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-1-Butene, 3-	000563-45-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-1-Pentene, 2-	000763-29-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-1-Pentene, 4-	000691-37-2	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-2-Butene, 2-	000513-35-9	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-2-Pentene, 2-	000625-27-4	NA	NA	NA	NA	NA	NA	NA	NA
Methylcyclohexane	000108-87-2	NA	3.00E+00 b	NA	NA	NA	NA	NA	NA
Methylcyclopentane	000096-37-7	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride (Dichloromethane)	000075-09-2	6.00E-02 a	3.00E+00 a	2.10E-07 a	7.50E-03 a	4.70E-07 a	NA	5.00E+01 a	2.00E+01 a
Methylene Diphenyl Diisocyanate (MDI)	000101-68-8	NA	2.00E-05 b	NA	NA	NA	NA	NA	NA
Methylene bis(2-chloroaniline), 4,4'-	000101-14-4	7.00E-04 b	NA	3.70E-06 b	1.30E-01 b	3.70E-05 b	1.30E-01 b	NA	NA
Methylenedianiline, 4,4'-	000101-77-9	NA	NA	NA	NA	NA	NA	NA	NA
Methylheptane, 2-		NA	NA	NA	NA	NA	NA	NA	NA
Methylhexane, 3-	000589-34-4	NA	NA	NA	NA	NA	NA	NA	NA
Methylhydantoin, 5-Ethyl-1,3-diglycidyl-5-	000592-27-8	NA	NA	NA	NA	NA	NA	NA	NA
Methylmercuric Dicyanamide	000502-39-6	NA	NA	NA	NA	NA	NA	NA	NA
Methylnaphthalene, 2-	000091-57-6	NA	NA	NA	NA	NA	NA	NA	NA

Revision: 04/06/95

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk $(\mu g/L)^{-1}$	Oral: Slope Factor $(mg/kg/day)^{-1}$	Inhalation: Unit Risk $(\mu g/m^3)^{-1}$	Inhalation: Slope Factor $(mg/kg/day)^{-1}$	Risk Concentration: µg/L at 10^{-5} Cancer Risk	Risk Concentration: $\mu g/m^3$ at 10^{-5} Cancer Risk
Methylpentane, 2-	000107-83-5	NA	NA	NA	NA	NA	NA	NA	NA
Methylpentane, 3-	000096-14-0	NA	NA	NA	NA	NA	NA	NA	NA
Methyltrichlorosilane	000075-79-6	NA	NA	NA	NA	NA	NA	NA	NA
Methytinaphthalene, 1-	001321-94-4	NA	NA	NA	NA	NA	NA	NA	NA
Mevinphos (Phosdrin)	007786-34-7	NA	NA	NA	NA	NA	NA	NA	NA
Mexacarbate	000315-18-4	NA	NA	NA	NA	NA	NA	NA	NA
Mineral fibers		NA	NA	NA	NA	NA	NA	NA	NA
Mitomycin C	000050-07-7	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum	007439-98-7	5.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Molybdenum (Insoluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum (Soluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Monocrotophos	006923-22-4	NA	NA	NA	NA	NA	NA	NA	NA
Monoethylamine (Ethylamine)	000075-04-7	NA	NA	NA	NA	NA	NA	NA	NA
Muscimol	002763-94-4	NA	NA	NA	NA	NA	NA	NA	NA
Mustard Gas	000505-60-2	NA	NA	NA	NA	NA	NA	NA	NA
Myrcene	000123-35-3	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	000091-20-3	4.00E-02 [b]	NA	NA	NA	NA	NA	NA	NA
Naphthaleneamine, 2-		NA	NA	NA	NA	NA	NA	NA	NA
Naphthylamine, 2-	000091-59-8	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	007440-02-0	2.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Nickel (Metal)	007440-02-0	NA	NA	NA	NA	NA	NA	NA	NA
Nickel (Refinery dust)	007440-02-0	NA	NA	NA	NA	2.40E-04 [a]	8.40E-01 [b]	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk $(\mu g/L)^{-1}$	Slope Factor $(mg/kg/day)^{-1}$	Unit Risk $(\mu g/m^3)^{-1}$	Slope Factor $(mg/kg/day)^{-1}$	$\mu g/L$ at 10^{-5} Cancer Risk	$\mu g/m^3$ at 10^{-5} Cancer Risk
Nickel (Soluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Nickel (Soluble salts)		NA	NA	NA	NA	NA	NA	NA	NA
Nickel Carbonyl	013463-39-3	NA	NA	NA	NA	NA	NA	NA	NA
Nicotine	000054-11-5	NA	NA	NA	NA	NA	NA	NA	NA
Nicotine Sulfate	000065-30-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitric Acid	007697-37-2	NA	NA	NA	NA	NA	NA	NA	NA
Nitric Oxide	010102-43-9	NA	NA	NA	NA	NA	NA	NA	NA
Nitrobenzene	000098-95-3	5.00E-04 [a]	2.00E-03 [a]	NA	NA	NA	NA	NA	NA
Nitrobiphenyl, 4- (or 4-Nitrodiphenyl)	000092-93-3	NA	NA	NA	NA	NA	NA	NA	NA
Nitrocellulose	009004-70-0	NA	NA	NA	NA	NA	NA	NA	NA
Nitrocyclohexane	001122-60-7	NA	NA	NA	NA	NA	NA	NA	NA
Nitrodiphenylamine, 2-	000199-75-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitrodiphenylamine, 4-	000836-30-6	NA	NA	NA	NA	NA	NA	NA	NA
Nitrogen Dioxide	010102-44-0	NA	NA [k]	NA	NA	NA	NA	NA	NA
Nitroglycerine	000055-63-0	NA	NA	NA	NA	NA	NA	NA	NA
Nitroguanidine	000556-88-7	1.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Nitromethane	000075-52-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitronaphthalene, 2-	000581-89-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitrophenol, 4-	000100-02-7	NA	NA	NA	NA	NA	NA	NA	NA
Nitrophenol, o-	000088-75-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitropropane, 2-	000079-46-9	NA	2.00E-02 [a]	NA	9.50E+00 [b]	2.70E+03 [b]	9.40E+00 [b]	NA	NA
Nitropyrene, 1-		NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk (µg/L)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	Unit Risk (µg/m^3)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	µg/L at 10^{-5} Cancer Risk	µg/m^3 at 10^{-5} Cancer Risk
Nitroso-N-methylurea, N-	000684-93-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitrosochethylamine, N-		NA	NA	NA	NA	NA	NA	NA	NA
Nitrosodimethylamine, N-	000062-75-9	NA	NA	1.40E-03 [a]	5.10E+01 [a]	1.40E-02 [a]	5.10E+01 [b]	7.00E-03 [a]	7.00E-04 [a]
Nitrosodiphenylamine, 4-	000156-10-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitrosodiphenylamine, N-	000086-30-6	NA	NA	1.40E-07 [a]	4.90E-03 [a]	NA	NA	7.00E+01	NA
Nitrosomorpholine, N-	000059-89-2	NA	NA	NA	NA	NA	NA	NA	NA
Nonane, n-	000111-84-2	NA	NA	NA	NA	NA	NA	NA	NA
Norbormide	000991-42-4	NA	NA	NA	NA	NA	NA	NA	NA
Octane, n-	000111-65-9	NA	NA	NA	NA	NA	NA	NA	NA
Organorthodium Complex (PMN-92-147)		NA	NA	NA	NA	NA	NA	NA	NA
Ouabain	000630-60-4	NA	NA	NA	NA	NA	NA	NA	NA
Oxamyl	023135-22-0	2.50E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Oxetane, 3,3-Bis(chloromethyl)-	000078-71-7	NA	NA	NA	NA	NA	NA	NA	NA
Oxydisulfoton	002497-07-6	NA	NA	NA	NA	NA	NA	NA	NA
Ozone	010028-15-6	NA	NA	NA	NA	NA	NA	NA	NA
Paraquat	004685-14-7	4.50E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Paraquat Methosulfate	002074-50-2	NA	NA	NA	NA	NA	NA	NA	NA
Parathion	000056-38-2	1.00E-02 [b]	NA	NA	NA	NA	NA	NA	NA
Parathion, Methyl	000298-00-0	2.50E-04 [a]	NA	NA	NA	NA	NA	NA	NA
Paris Green	012002-03-8	NA	NA	NA	NA	NA	NA	NA	NA
Particulates (PM10)		NA	NA	NA	NA	NA	NA	NA	NA
Particulates (PM10, total dust)		NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk (µg/L)$^{-1}$	Oral: Slope Factor (mg/kg/day)$^{-1}$	Inhalation: Unit Risk (µg/m^3)$^{-1}$	Inhalation: Slope Factor (mg/kg/day)$^{-1}$	Risk Concentration: µg/L at 10^{-5} Cancer Risk	Risk Concentration: µg/m^3 at 10^{-5} Cancer Risk
Pentaborane	019624-22-7	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloronitrobenzene (Quintobenzene)	000082-68-8	3.00E-03 [a]	NA	7.40E-06 [b]	2.60E-01 [b]	NA	NA	NA	NA
Pentachlorophenol	000087-86-5	3.00E-02 [a]	NA	3.00E-06 [a]	1.20E-01 [a]	NA	NA	3.00E+00	NA
Pentadecylamine	002570-26-5	NA	NA	NA	NA	NA	NA	NA	NA
Pentaerythritol Tetranitrate (PETN)	000078-11-5	NA	NA	NA	NA	NA	NA	NA	NA
Pentene	025377-72-4	NA	NA	NA	NA	NA	NA	NA	NA
Pentene, 1-	000109-67-1	NA	NA	NA	NA	NA	NA	NA	NA
Pentene, cis-2-	000627-20-3	NA	NA	NA	NA	NA	NA	NA	NA
Pentene, trans-2-	000646-04-8	NA	NA	NA	NA	NA	NA	NA	NA
Peracetic Acid	000079-21-0	NA	NA	NA	NA	NA	NA	NA	NA
Perchloromethylmercaptan	000594-42-3	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	000085-01-8	NA	NA	NA	NA	NA	NA	NA	NA
Phenol	000108-95-2	6.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Phenol, 2,2 Thiobis(4-chloro-6-methyl)-	004418-66-0	NA	NA	NA	NA	NA	NA	NA	NA
Phenol, 3-(1 Methylethyl)-, Methylcarbamate	000064-00-6	NA	NA	NA	NA	NA	NA	NA	NA
Phenoxarsine, 10, 10-Oxydi-	000058-36-6	NA	NA	NA	NA	NA	NA	NA	NA
Phenyl Dichloroarsine	000696-28-6	NA	NA	NA	NA	NA	NA	NA	NA
Phenyldiisodecyl Phosphite		NA	NA	NA	NA	NA	NA	NA	NA
Phenylenediamine, p	000106-50-3	1.90E-01 [b]	NA	NA	NA	NA	NA	NA	NA
Phenylhydrazine Hydrochloride	000059-88-1	NA	NA	NA	NA	NA	NA	NA	NA
Phenylmercury Acetate	000062-38-4	8.00E-05 [a]	NA	NA	NA	NA	NA	NA	NA
Phenylsilatrane	002097-19-0	NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk $(\mu g/L)^{-1}$	Slope Factor $(mg/kg/day)^{-1}$	Unit Risk $(\mu g/m^3)^{-1}$	Slope Factor $(mg/kg/day)^{-1}$	µg/L at 10^{-5} Cancer Risk	$\mu g/m^3$ at 10^{-5} Cancer Risk
Phenylthiourea	000103-85-5	NA	NA	NA	NA	NA	NA	NA	NA
Phorate	000298-02-2	2.00E-04 [b]	NA	NA	NA	NA	NA	NA	NA
Phosacetim	004104-14-7	NA	NA	NA	NA	NA	NA	NA	NA
Phosfolan	000947-02-4	NA	NA	NA	NA	NA	NA	NA	NA
Phosgene	000075-44-5	NA	NA	NA	NA	NA	NA	NA	NA
Phosmet	000732-11-6	2.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Phosphamidon	013171-21-6	NA	NA	NA	NA	NA	NA	NA	NA
Phosphine	007803-51-2	3.00E-04 [a]	3.00E-05 [a]	NA	NA	NA	NA	NA	NA
Phosphonothioic Acid, Methyl-, O-(4-nitrophenyl) O-phenyl ester	002665-30-7	NA	NA	NA	NA	NA	NA	NA	NA
Phosphonothioic Acid, Methyl-, O-ethyl O-(4-(methylthio)phenyl) ester	002703-13-1	NA	NA	NA	NA	NA	NA	NA	NA
Phosphonothioic Acid, Methyl-, S-(2-(Bis(1-methylethyl)amino)ethyl O-ethyl ester	050782-69-9	NA	NA	NA	NA	NA	NA	NA	NA
Phosphoric Acid, Dimethyl 4-(methylthio) phenyl ester	003254-63-5	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorothioic Acid, O,O-Dimethyl-S-(2-methylthio)ethyl ester	002587-90-8	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus	007723-14-0	2.00E-05 [a]	NA	NA	NA	NA	NA	NA	NA
Phosphorus (white, yellow)	007723-14-0	2.00E-05 [a]	NA	NA	NA	NA	NA	NA	NA
Phosphorus Oxychloride	010025-87-3	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus Pentachloride	010026-13-8	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus Pentoxide	001314-56-3	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus Trichloride	007719-12-2	NA	NA	NA	NA	NA	NA	NA	NA
Phthalic Anhydride	000085-44-9	2.00E+00 [a]	1.20E-01 [a]	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk ($\mu g/L$)$^{-1}$	Oral: Slope Factor (mg/kg/day)$^{-1}$	Inhalation: Unit Risk ($\mu g/m^3$)$^{-1}$	Inhalation: Slope Factor (mg/kg/day)$^{-1}$	Risk Concentration: $\mu g/L$ at 10^{-5} Cancer Risk	Risk Concentration: $\mu g/m^3$ at 10^{-5} Cancer Risk
Physostigmine	000057-47-6	NA	NA	NA	NA	NA	NA	NA	NA
Physotigmine, Salicylate (1:1)	000057-64-7	NA	NA	NA	NA	NA	NA	NA	NA
Picric acid	000088-89-1	NA	NA	NA	NA	NA	NA	NA	NA
Picrotoxin	000124-87-8	NA	NA	NA	NA	NA	NA	NA	NA
Pinene, alpha-	000080-56-8	NA	NA	NA	NA	NA	NA	NA	NA
Pinene, beta-	000127-91-3	NA	NA	NA	NA	NA	NA	NA	NA
Piperidine	000110-89-4	NA	NA	NA	NA	NA	NA	NA	NA
Pirimifos, Ethyl	023505-41-1	NA	NA	NA	NA	NA	NA	NA	NA
Polychlorinated Biphenyls (Aroclors)	001336-36-3	NA	NA	2.20E-04 [a]	7.70E+00 [a]	NA	NA	5.00E-02	NA
Polycylic Organic Matter		NA	NA	NA	NA	NA	NA	NA	NA
Polystyrene	009003-53-6	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	007440-09-7	NA	NA	NA	NA	NA	NA	NA	NA
Potassium Arsenide	010124-50-2	NA	NA	NA	NA	NA	NA	NA	NA
Potassium Cyanide	000151-50-8	5.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Potassium Hydroxide	001310-58-3	NA	NA	NA	NA	NA	NA	NA	NA
Potassium Nitrate	007757-79-1	NA	NA	NA	NA	NA	NA	NA	NA
Potassium Silver Cyanide	000506-61-6	2.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Promecarb	002631-37-0	NA	NA	NA	NA	NA	NA	NA	NA
Propane	000074-98-6	NA	NA	NA	NA	NA	NA	NA	NA
Propane Sultone, 1,3-	001120-71-4	NA	NA	NA	NA	NA	NA	NA	NA
Propargyl Bromide	000106-96-7	NA	NA	NA	NA	NA	NA	NA	NA
Propiolactone, Beta-	000057-57-8	NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk (μg/L)$^{-1}$	Oral: Slope Factor (mg/kg/day)$^{-1}$	Inhalation: Unit Risk (μg/m^3)$^{-1}$	Inhalation: Slope Factor (mg/kg/day)$^{-1}$	Risk Concentration: μg/L at 10^{-5} Cancer Risk	Risk Concentration: μg/m^3 at 10^{-5} Cancer Risk
Propionaldehyde	000123-38-6	NA	NA	NA	NA	NA	NA	NA	NA
Propionitrile	000107-12-0	NA	NA	NA	NA	NA	NA	NA	NA
Propionitrile, 3-Chloro-	000542-76-7	NA	NA	NA	NA	NA	NA	NA	NA
Propiophenone, 4-Amino-	000070-69-9	NA	NA	NA	NA	NA	NA	NA	NA
Propoxur (Baygon)	000114-26-1	4.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Propyl Adipate, di-N-	000106-19-4	NA	NA	NA	NA	NA	NA	NA	NA
Propyl Chloroformate	000109-61-5	NA	NA	NA	NA	NA	NA	NA	NA
Propylbenzene, 1-	000103-65-1	NA	NA	NA	NA	NA	NA	NA	NA
Propylene Dichloride (1,2-Dichloropropane)	000078-87-5	NA	4.00E-03 [a]	1.90E-06 [b]	6.80E-02 [b]	NA	NA	NA	NA
Propylene Oxide	000075-56-9	NA	3.00E-02 [a]	6.80E-06 [a]	2.40E-01 [a]	3.70E-06 [a]	1.30E-02 [b]	1.00E+00 [a]	3.00E+00 [a]
Propyleneimine	000075-55-8	NA	NA	NA	NA	NA	NA	NA	NA
Prothoate	002275-18-5	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	000129-00-0	3.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Pyridine, 2-Methyl-5-Vinyl-	000140-76-1	NA	NA	NA	NA	NA	NA	NA	NA
Pyridine, 4-Amino-	000504-24-5	2.00E-05 [b]	NA	NA	NA	NA	NA	NA	NA
Pyridine, 4-Nitro-, 1-Oxide	001124-33-0	NA	NA	NA	NA	NA	NA	NA	NA
Pyriminil	053558-25-1	NA	NA	NA	NA	NA	NA	NA	NA
Quinoline	000091-22-5	NA	NA	3.50E-04 [b]	1.20E+01 [b]	NA	NA	NA	NA
Quinone	000106-51-4	NA	NA	NA	NA	NA	NA	NA	NA
RDX (Cyclo-1,3,5-trimethylene-2,4,6-trinitramine)	000121-82-4	3.00E-03 [a]	NA	3.10E-06 [a]	1.10E-01 [a]	NA	NA	3.00E+00	NA
Radionuclides (Includes radon, See entries for specific compounds)		NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk (μg/L)$^{-1}$	Oral: Slope Factor (mg/kg/day)$^{-1}$	Inhalation: Unit Risk (μg/m^3)$^{-1}$	Inhalation: Slope Factor (mg/kg/day)$^{-1}$	Risk Concentration: μg/L at 10^{-5} Cancer Risk	Risk Concentration: μg/m^3 at 10^{-5} Cancer Risk
Resorcinol	000108-46-3	NA	NA	NA	NA	NA	NA	NA	NA
Salane, (4-Aminobutyl)diethoxymethyl-	003037-72-7	NA	NA	NA	NA	NA	NA	NA	NA
Salcomine	014167-18-1	NA	NA	NA	NA	NA	NA	NA	NA
Salicylic Acid	000069-72-7	NA	NA	NA	NA	NA	NA	NA	NA
Sarin	000107-44-8	NA	NA	NA	NA	NA	NA	NA	NA
Selenious Acid	007783-00-8	5.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Selenium	007782-49-2	5.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Selenium Compounds (as Se)		5.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Selenium Oxychloride	007791-23-3	NA	NA	NA	NA	NA	NA	NA	NA
Semicarbazide Hydrochloride	000563-41-7	NA	NA	NA	NA	NA	NA	NA	NA
Silane, Trichloro(chloromethyl)-	001558-25-4	NA	NA	NA	NA	NA	NA	NA	NA
Silane, Trichloro(dichloropheny)-	027137-85-5	NA	NA	NA	NA	NA	NA	NA	NA
Silicon	007440-21-3	NA	NA	NA	NA	NA	NA	NA	NA
Silicon (Total dust)	007440-21-3	NA	NA	NA	NA	NA	NA	NA	NA
Silver (Metal dust and fume)	007440-22-4	NA	NA	NA	NA	NA	NA	NA	NA
Silver (Metal dust and soluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Silver (Metal dust, soluble compounds, and fumes)		NA	NA	NA	NA	NA	NA	NA	NA
Silver (Soluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Silver (metal)	007440-22-4	5.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Sodium Arsenate	007631-89-2	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Arsenite	007784-46-5	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Azide	026628-22-8	4.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk $(\mu g/L)^{-1}$	Oral: Slope Factor $(mg/kg/day)^{-1}$	Inhalation: Unit Risk $(\mu g/m^3)^{-1}$	Inhalation: Slope Factor $(mg/kg/day)^{-1}$	Risk Concentration: $\mu g/L$ at 10^{-5} Cancer Risk	Risk Concentration: $\mu g/m^3$ at 10^{-5} Cancer Risk
Sodium Cacodylate	000124-65-2	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Cyanide	000143-33-9	4.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Sodium Fluoroacetate	000062-74-8	2.00E-05 [a]	NA	NA	NA	NA	NA	NA	NA
Sodium Nitrate	007631-99-4	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Selenate	013410-01-0	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Selenite	010102-18-8	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Tellurite	010102-20-2	NA	NA	NA	NA	NA	NA	NA	NA
Stannane, Acetoxytriphenyl-	000900-95-8	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	007440-24-6	6.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Strychnine	000057-24-9	3.00E-04 [a]	NA	NA	NA	NA	NA	NA	NA
Strychnine Sulfate	000060-41-3	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	000100-42-5	2.00E-01 [a]	1.00E+00 [a]	NA	NA	NA	NA	NA	NA
Styrene Oxide	000096-09-3	NA	NA	NA	NA	NA	NA	NA	NA
Sulfotep (Tetraethyldithiopyrophosphate or TEDP)	003689-24-5	5.00E-04 [a]	NA	NA	NA	NA	NA	NA	NA
Sulfoxide, 3-Chloropropyl octyl	003569-57-1	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur	007704-34-9	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur Dioxide	007446-09-5	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur Dioxide, Anhydrous		NA	NA	NA	NA	NA	NA	NA	NA
Sulfur Tetrafluoride	007783-60-0	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur Trioxide	007446-11-9	NA	NA	NA	NA	NA	NA	NA	NA
Sulfuric Acid	007664-93-9	NA	NA	NA	NA	NA	NA	NA	NA
TEPP	000107-49-3	NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk $(\mu g/L)^{-1}$	Slope Factor $(mg/kg/day)^{-1}$	Unit Risk $(\mu g/m^3)^{-1}$	Slope Factor $(mg/kg/day)^{-1}$	$\mu g/L$ at 10^{-5} Cancer Risk	$\mu g/m^3$ at 10^{-5} Cancer Risk
Tabun	000077-81-6	NA	NA	NA	NA	NA	NA	NA	NA
Tellurium	013494-80-9	NA	NA	NA	NA	NA	NA	NA	NA
Tellurium Hexafluoride	007783-80-4	NA	NA	NA	NA	NA	NA	NA	NA
Terbufos	013071-79-9	2.50E-05 [b]	NA	NA	NA	NA	NA	NA	NA
Terpinene, alpha-	000099-86-5	NA	NA	NA	NA	NA	NA	NA	NA
Terpinene, delta-		NA	NA	NA	NA	NA	NA	NA	NA
Terpinolene	000586-62-9	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	001746-01-6	NA	NA	4.50E+00 [b]	1.50E+05 [b]	3.30E-05 [b,h]	1.50E+05 [b]	NA	NA
Tetrachloroethane, 1,1,2,2-	000079-34-5	NA	NA	5.80E-06 [a]	2.00E-01 [a]	5.80E-05 [a]	2.00E-01 [b]	2.00E-00 [a]	2.00E-01 [a]
Tetrachloroethylene (Perchloroethylene)	000127-18-4	1.00E-02 [a]	NA	NA	NA	NA	NA	NA	NA
Tetranitromethane	000509-14-8	NA	NA	NA	NA	NA	NA	NA	NA
Tetryl (Trinitro-2,4-6-phenylmethylnitramine)	000479-45-8	1.00E-02 [b]	NA	NA	NA	NA	NA	NA	NA
Thallium Sulfate	010031-59-1	NA	NA	NA	NA	NA	NA	NA	NA
Thallous Carbonate	006533-73-9	8.00E-05 [a]	NA	NA	NA	NA	NA	NA	NA
Thallous Chloride	007791-12-0	8.00E-05 [a]	NA	NA	NA	NA	NA	NA	NA
Thallous Malonate	002757-18-8	NA	NA	NA	NA	NA	NA	NA	NA
Thallous Sulfate	007446-18-6	8.00E-05 [a]	NA	NA	NA	NA	NA	NA	NA
Thiocarbazide	002231-57-4	NA	NA	NA	NA	NA	NA	NA	NA
Thiofanox	039196-18-4	3.00E-04 [b]	NA	NA	NA	NA	NA	NA	NA
Thionazin	000297-97-2	NA	NA	NA	NA	NA	NA	NA	NA
Thiophenol	000108-98-5	1.00E-05 [b]	NA	NA	NA	NA	NA	NA	NA
Thiosemicarbazide	000079-19-6	NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk (μg/L)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	Unit Risk (μg/m^3)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	μg/L at 10^{-5} Cancer Risk	μg/m^3 at 10^{-5} Cancer Risk
Thiourea, (2-Chlorophenyl)-	005344-82-1	NA	NA	NA	NA	NA	NA	NA	NA
Thiourea, (2-Methylphenyl)-	000614-78-8	NA	NA	NA	NA	NA	NA	NA	NA
Tin (Metal)	007440-31-5	NA	NA	NA	NA	NA	NA	NA	NA
Tin (Organic compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Tin (Oxide and inorganic compounds except SnH4)		NA	NA	NA	NA	NA	NA	NA	NA
Tin (and compounds)		6.00E-01 [b]	NA	NA	NA	NA	NA	NA	NA
Tin (Inorganic compounds except oxides)	007440-31-5	NA	NA	NA	NA	NA	NA	NA	NA
Tin, Tetraethyl	000597-64-8	NA	NA	NA	NA	NA	NA	NA	NA
Titanium	007440-32-6	NA	NA	NA	NA	NA	NA	NA	NA
Titanium Tetrachloride	007550-45-0	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	000108-88-3	2.00E-01 [a]	4.00E-01 [a]	NA	NA	NA	NA	NA	NA
Toluene 2,6-Diisocyanate	000091-08-7	NA	NA	NA	NA	NA	NA	NA	NA
Toluene Diamine, 2,4-	000095-80-7	NA	NA	9.10E-05 [b]	3.20E+00 [b]	NA	NA	NA	NA
Toluene Diisocyanate	026471-62-5	NA	NA	NA	NA	NA	NA	NA	NA
Toluene, 2,4-Diisocyanate	000584-84-9	NA	NA	NA	NA	NA	NA	NA	NA
Toluidine, o-	000095-53-4	NA	NA	6.90E-06 [b]	2.40E-01 [b]	NA	NA	NA	NA
Toxaphene (Chlorinated camphene)	008001-35-2	NA	NA	3.30E-05 [a]	1.10E+00 [a]	3.20E-04 [a]	1.10E+00 [b]	3.00E-01 [a]	3.00E-02 [a]
Triacetin	000102-76-1	NA	NA	NA	NA	NA	NA	NA	NA
Triamiphos	001031-47-6	NA	NA	NA	NA	NA	NA	NA	NA
Triazofos	024017-47-8	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroacetyl Chloride	000076-02-8	NA	NA	NA	NA	NA	NA	NA	NA
Trichlorobenzene, 1,2,4-	000120-82-1	1.00E-02 [a]	2.00E-01 [a]	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk (μg/L)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	Unit Risk (μg/m^3)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	μg/L at 10^{-5} Cancer Risk	μg/m^3 at 10^{-5} Cancer Risk
Trichloroethane, 1,1,2-	000079-00-5	4.00E-03 [a]	NA	1.60E-06 [a]	5.70E-02 [a]	1.60E-05 [a]	5.70E-02 [b]	6.00E-00 [a]	6.00E-01 [a]
Trichloroethylene	000079-01-6	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethylsilane	000115-21-9	NA	NA	NA	NA	NA	NA	NA	NA
Trichloronate	000327-98-0	NA	NA	NA	NA	NA	NA	NA	NA
Trichlorophenol, 2,4,5-	000095-95-4	1.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Trichlorophenol, 2,4,6-	000088-06-2	NA	NA	3.10E-07 [a]	1.10E-02 [a]	3.10E-06 [a]	1.00E-02 [b]	3.00E+01 [a]	3.00E+00 [a]
Trichlorophenylsilane	000098-13-5	NA	NA	NA	NA	NA	NA	NA	NA
Triethoxysilane	000998-30-1	NA	NA	NA	NA	NA	NA	NA	NA
Triethylamine	000121-44-8	NA	7.00E-03 [a]	NA	NA	NA	NA	NA	NA
Trifluralin	001582-09-8	7.50E-03 [a]	NA	2.20E-07 [a]	7.70E-03 [a]	NA	NA	5.00E+01	NA
Trimethyl-3-phenylindane, 1,1,3-	003910-35-8	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylbenzene, 1,2,4-	000095-63-6	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylbenzene, 1,3,5-	000108-67-8	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylchlorosilane	000075-77-4	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylolpropane Phosphite	000824-11-3	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylpentane, 2,2,3-	054665-47-3	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylpentane, 2,2,4-	000540-84-1	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylpentane, 2,3,4-	000565-75-3	NA	NA	NA	NA	NA	NA	NA	NA
Trimethyltin Chloride	001066-45-1	NA	NA	NA	NA	NA	NA	NA	NA
Trinitroanisole	028653-16-9	NA	NA	NA	NA	NA	NA	NA	NA
Trinitrobenzene, 1,3,5-	000099-35-4	5.00E-05 [a]	NA	NA	NA	NA	NA	NA	NA
Trinitroglycerol	000055-63-0	NA	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic: Oral RfD (mg/kg/day)	Chronic: Inhalation RfC (mg/m^3)	Oral: Unit Risk $(\mu g/L)^{-1}$	Oral: Slope Factor $(mg/kg/day)^{-1}$	Inhalation: Unit Risk $(\mu g/m^3)^{-1}$	Inhalation: Slope Factor $(mg/kg/day)^{-1}$	Risk Concentration: µg/L at 10^{-5} Cancer Risk	Risk Concentration: $\mu g/m^3$ at 10^{-5} Cancer Risk
Trinitrotoluene, 2,4,6-	000118-96-7	5.00E-04 [a]	NA	9.00E-07 [a]	3.00E-02 [a]	NA	NA	1.00E+01 [a]	NA
Triphenyltin Chloride	000639-58-7	NA	NA	NA	NA	NA	NA	NA	NA
Tris(2-Chloroethyl) Amine	000555-77-1	NA	NA	NA	NA	NA	NA	NA	NA
Uranium	007440-61-1	NA	NA	NA	NA	NA	NA	NA	NA
Uranium (Insoluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Uranium (Natural)	007440-61-1	NA	NA	NA	NA	NA	NA	NA	NA
Uranium (Soluble and insoluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Uranium (Soluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Uranium Soluble Salts		3.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Valinomycin	002001-95-8	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	007440-62-2	7.00E-03 [b]	NA	NA	NA	NA	NA	NA	NA
Vanadium Pentoxide (as V2O5)	001314-62-1	9.00E-03 [a]	NA	NA	NA	NA	NA	NA	NA
Vinyl Acetate	000108-05-4	1.00E+00 [b]	2.00E-01 [b]	NA	NA	NA	NA	NA	NA
Vinyl Bromide	000593-60-2	NA	3.00E-03 [a]	NA	NA	3.20E-05 [b]	1.10E-01 [b]	NA	NA
Vinyl Chloride	000075-01-4	NA	NA	5.40E-05 [b]	1.90E+00 [b]	8.40E-05 [b]	3.00E-01 [b]	NA	NA
Vinylidene Chloride (1,1-Dichloroethylene)	000075-35-4	9.00E-03 [a]	NA	1.70E-05 [a]	6.00E-01 [a]	5.00E-05 [a]	1.20E+00 [b]	6.00E-01 [a]	2.00E-01 [a]
Warfarin	000081-81-2	3.00E-04 [a]	NA	NA	NA	NA	NA	NA	NA
Warfarin, Sodium	000129-06-6	NA	NA	NA	NA	NA	NA	NA	NA
Xylene (all isomers)	001330-20-7	2.00E+00 [a,g]	NA	NA	NA	NA	NA	NA	NA
Xylene Dichloride	028347-13-9	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, m-	000108-38-3	2.00E+00 [b,g]	NA	NA	NA	NA	NA	NA	NA
Xylene, o-	000095-47-6	2.00E+00 [b,g]	NA	NA	NA	NA	NA	NA	NA

EPA HEALTH-BASED TOXICITY CRITERIA

Chemical	CAS Number	Chronic		Oral		Inhalation		Risk Concentration	
		Oral RfD (mg/kg/day)	Inhalation RfC (mg/m^3)	Unit Risk (μg/L)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	Unit Risk (μg/m^3)$^{-1}$	Slope Factor (mg/kg/day)$^{-1}$	μg/L at 10^{-5} Cancer Risk	μg/m^3 at 10^{-5} Cancer Risk
Xylene, p-	000106-42-3	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes (isomers and mixture)	001330-20-7	2.00E+00 [a,g]	NA	NA	NA	NA	NA	NA	NA
Xylenes (isomers and mixture) -m	000108-38-3	2.00E+00 [b,g]	NA	NA	NA	NA	NA	NA	NA
Xylenes (isomers and mixture) -o	000095-47-6	2.00E+00 [b,g]	NA	NA	NA	NA	NA	NA	NA
Xylenes (isomers and mixture) -p	000106-42-3	NA	NA	NA	NA	NA	NA	NA	NA
Zinc (metallic)	007440-66-6	3.00E-01 [a]	NA	NA	NA	NA	NA	NA	NA
Zinc Oxide (dust)	001314-13-2	NA	NA	NA	NA	NA	NA	NA	NA
Zinc Oxide (fume)	001314-13-2	NA	NA	NA	NA	NA	NA	NA	NA
Zinc Phosphide	001314-84-7	3.00E-04 [a]	NA	NA	NA	NA	NA	NA	NA
Zinc, Dichloro(4,4-dimethyl-5(((methylamino) carbonyl)oxy)imino)pentanenitrile)-(T-4)	058270-08-9	NA	NA	NA	NA	NA	NA	NA	NA
Zirconium (and compounds)		NA	NA	NA	NA	NA	NA	NA	NA

NA = Not Available

[a] Source: Integrated Risk Information System (IRIS), June 1993

[b] Source: Health and Environmental Affects Summary Table (HEAST), 1993

[c] The RfC was derived from methodology (dose conversions from mg/kg/day to mg/m^3) that is not current with the interim inhalation methodology used by the RfD/RfC Work Group.

[d] Contact the Superfund Health Risk Technical Support Center: (513) 569-7300

[e] Oral RfD is for water, food RfD = 1.40E-01 mg/kg/day.

[f] Oral RfD is for water, food RfD = 1.00E-03 mg/kg/day (IRIS)

[g] Value is for total xylenes

[h] (pg/m^3)$^{-1}$

[i] Data comes from IRIS file on mixture of DNT, 2,4- and DNT, 2,6-

[j] HEAST concluded that toxicity data were inadequate for calculation of oral RfDs for copper and substituted the current drinking water standard (MCLG) of 1.3 mg/L.

[k] An inhalation RfC will not be derived for nitrogen dioxide because NAAQS is available (0.053 ppm annual arithmetic mean concentration).

ENVIRONMENTAL STANDARDS CRITERIA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
ANTU	000086-88-4	NA	NA	NA	NA	NA	NA	NA	NA
Acetaldehyde	000075-07-0	NA	NA	NA	NA	NA	NA	NA	NA
Acetamide	000060-35-5	NA	NA	NA	NA	NA	NA	NA	NA
Acetone Cyanohydrin	000075-86-5	NA	NA	NA	NA	NA	NA	NA	NA
Acetone Thiosemicarbazide	001752-30-3	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	000075-05-8	NA	NA	2.00E-01	5.00E+02	NA	NA	NA	NA
Acetophenone	000098-86-2	NA	2.00E-01	4.00E-00	8.00E+03	NA	NA	NA	NA
Acetylaminofluorene, 2-	000053-96-3	NA	NA	NA	NA	NA	NA	NA	NA
Acetylene	000074-86-2	NA	NA	NA	NA	NA	NA	NA	NA
Acrolein	000107-02-8	NA	NA	NA	NA	NA	NA	7.80E+02	3.20E+02
Acrylamide	000079-06-1	NA	8.00E-04	8.00E-06	2.00E-01	NA	NA	NA	NA
Acrylic Acid	000079-10-7	NA	NA	NA	NA	NA	NA	NA	NA
Acrylonitrile	000107-13-1	NA	1.00E-02	6.00E-05	1.00E-00	NA	NA	6.60E-01[f]	5.90E-02[f]
Acrylyl Chloride	000814-68-6	NA	NA	NA	NA	NA	NA	NA	NA
Adiponitrile	000111-69-3	NA	NA	NA	NA	NA	NA	NA	NA
Aldicarb	000116-06-3	NA	NA	5.00E-02	1.00E+02	NA	NA	NA	NA
Aldrin	000309-00-2	NA	2.00E-04	2.00E-06	4.00E-02	3.00E+00[p]	NA	1.40E-04[f]	1.30E-04[f]
Allyl Alcohol	000107-18-6	NA	NA	2.00E-01	4.00E+02	NA	NA	NA	NA
Allyl Chloride	000107-05-1	NA	NA	NA	NA	NA	NA	NA	NA
Allylamine	000107-11-9	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum	007429-90-5	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum (alkyls)		NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Aluminum (metal dust, respirable fraction)	007429-90-5	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum (pyro powders)		NA	NA	NA	NA	NA	NA	NA	NA
Aluminum (soluble salts)		NA	NA	NA	NA	NA	NA	NA	NA
Aluminum (welding fume)	007429-90-5	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum Phosphide	020859-73-8	NA	NA	1.00E-02	3.00E+01	NA	NA	NA	NA
Aminobiphenyl, 4-	000092-67-1	NA	NA	NA	NA	NA	NA	NA	NA
Aminopterin	000054-62-6	NA	NA	NA	NA	NA	NA	NA	NA
Amiton	000078-53-5	NA	NA	NA	NA	NA	NA	NA	NA
Amiton Oxalate	003734-97-2	NA	NA	NA	NA	NA	NA	NA	NA
Ammonia	007664-41-7	NA	NA	NA	NA	NA	NA	NA	NA
Ammonium Nitrate	006484-52-2	NA	NA	NA	NA	NA	NA	NA	NA
Ammonium Picrate	000131-74-8	NA	NA	NA	NA	NA	NA	NA	NA
Amosite	012172-73-5	NA	NA	NA	NA	NA	NA	NA	NA
Amphetamine	000300-62-9	NA	NA	NA	NA	NA	NA	NA	NA
Aniline	000062-53-3	NA	NA	6.00E-03	1.00E+02	NA	NA	NA	NA
Aniline, 2,4,6-Trimethyl-	000088-05-1	NA	NA	NA	NA	NA	NA	NA	NA
Anisidine, o-	000090-04-0	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	000120-12-7	NA	NA	NA	NA	NA	NA	1.10E+05	9.60+03
Antimony	007440-36-0	NA	NA	1.00E-02	3.00E+01	NA	NA	4.30E+03	1.40E+01
Antimony Compounds (as Sb)		NA	NA	1.00E-02	3.00E+01	NA	NA	4.30E+03	1.40E+01
Antimony Pentafluoride	007783-70-2	NA	NA	NA	NA	NA	NA	NA	NA
Antimycin A	001397-94-0	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Arsenic	007440-38-2	NA	7.00E-05	Use MCL	8.00E+01	3.60E+02 [i]	1.90E+02 [i]	1.40E-01 [f]	1.80E-02 [f]
Arsenic (Inorganic compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Arsenic (Organic compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Arsenic Pentoxide	001303-28-2	NA	NA	NA	NA	NA	NA	NA	NA
Arsenous Oxide	001327-53-3	NA	NA	NA	NA	NA	NA	NA	NA
Arsenous Trichloride	007784-34-1	NA	NA	NA	NA	NA	NA	NA	NA
Arsine	007784-42-1	NA	NA	NA	NA	NA	NA	NA	NA
Asbestos	001332-21-4	NA	2.00E-02	NA	NA	NA	NA	Use MCL	7.00E+06 [k]
Azinphos-Ethyl	002642-71-9	NA	NA	NA	NA	NA	NA	NA	NA
Azinphos-Methyl	000086-50-0	NA	NA	NA	NA	NA	NA	NA	NA
Barium	007440-39-3	NA	4.00E-01	Use MCL	4.00E+03	NA	NA	NA	NA
Barium (Soluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Barium Nitrate	010022-31-8	NA	NA	NA	NA	NA	NA	NA	NA
Benzal Chloride	000098-87-3	NA	NA	NA	NA	NA	NA	NA	NA
Benzenamine, 3-(Trifluoromethyl)	000098-16-8	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	000071-43-2	NA	NA	NA	NA	NA	NA	7.10E+01 [f]	1.20E+00 [f]
Benzene, 1-(Chloromethyl)-4-nitro-	000100-14-1	NA	NA	NA	NA	NA	NA	NA	NA
Benzenearsonic Acid	000098-05-5	NA	NA	NA	NA	NA	NA	NA	NA
Benzidine	000092-87-5	NA	2.00E-05	2.00E-07	3.00E-03	NA	NA	5.40E-04 [f]	1.20E-04 [f]
Benzimidazole, 4,5-Dichloro-2-(trifluoromethyl)	003615-21-2	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	000056-55-3	NA	NA	NA	NA	NA	NA	3.10E-02 [f]	2.80E-03 [f]
Benzo(a)pyrene (also see Coal Tar Pitch Volatiles)	000050-32-8	NA	NA	NA	NA	NA	NA	3.10E-02 [f]	2.80E-03 [f]

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS (μg/m³)[c]	RCRA Action Levels[a] Air (μg/m³)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute (μg/L)	Freshwater Life[b,d] Chronic (μg/L)	Human Health[e] Fish (μg/L)	Human Health[e] Fish/Water (μg/L)
Benzo(b)fluoranthene	000205-99-2	NA	NA	NA	NA	NA	NA	3.10E-02[f]	2.80E-03[f]
Benzo(c)acridine		NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	000207-08-9	NA	NA	NA	NA	NA	NA	3.10E-02[f]	2.80E-03[f]
Benzotrichloride	000098-07-7	NA	NA	NA	NA	NA	NA	NA	NA
Benzyl Alcohol	000100-51-6	NA	NA	NA	NA	NA	NA	NA	NA
Benzyl Chloride	000100-44-7	NA	NA	NA	NA	NA	NA	NA	NA
Benzyl Cyanide	000140-29-4	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	007440-41-7	NA	4.00E-04	8.00E-06	2.00E-01	NA	NA	NA[j]	NA[j]
Beryllium Compounds (as Be)		NA	4.00E-04	8.00E-06	2.00E-01	NA	NA	NA[j]	NA[j]
Bicyclo [2.2.1] Heptane-2-carbonitrile, 5-chlor-6-((((methylamino)carbonyl) oxy)imino)-(1	015271-41-7	NA	NA	NA	NA	NA	NA	NA	NA
Biphenyl (diphenyl)	000092-52-4	NA	NA	NA	NA	NA	NA	NA	NA
Bitoscanate	004044-65-9	NA	NA	NA	NA	NA	NA	NA	NA
Boric Acid	010043-35-3	NA	NA	NA	NA	NA	NA	NA	NA
Boron	007440-42-8	NA	NA	NA	NA	NA	NA	NA	NA
Boron Trichloride	010294-34-5	NA	NA	NA	NA	NA	NA	NA	NA
Boron Trifluoride	007637-07-2	NA	NA	NA	NA	NA	NA	NA	NA
Boron Trifluoride Compound with Methyl Ether (1:1)	000353-42-4	NA	NA	NA	NA	NA	NA	NA	NA
Bromadiolone	028772-56-7	NA	NA	NA	NA	NA	NA	NA	NA
Bromine	007726-95-6	NA	NA	NA	NA	NA	NA	NA	NA
Bromoform	000075-25-2	NA	NA	7.00E-01	2.00E+03	NA	NA	3.60E+02[f]	4.30E+00[f]
Butadiene, 1,3-	000106-99-0	NA	NA	NA	NA	NA	NA	NA	NA
Butane, I-		NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Butane, n-	000106-97-8	NA	NA	NA	NA	NA	NA	NA	NA
Butene, 1-	000106-98-9	NA	NA	NA	NA	NA	NA	NA	NA
Butene, cis-2-	000590-18-1	NA	NA	NA	NA	NA	NA	NA	NA
Butene, l-		NA	NA	NA	NA	NA	NA	NA	NA
Butene, trans-2-	000624-64-6	NA	NA	NA	NA	NA	NA	NA	NA
Butyl benzyl phthalate	000085-68-7	NA	NA	7.00E-00	2.00E+04	NA	NA	NA	NA
Butylbenzene, sec-	000135-98-8	NA	NA	NA	NA	NA	NA	NA	NA
Butylphenol, 2,2-Methylene bis(4-methyl) 6-t-butylphen-		NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	007440-43-9	NA	6.00E-04	Use MCL	4.00E+01	3.90E+00 [g,i]	1.10E+00 [g,i]	NA [j]	NA [j]
Cadmium (dust)	007440-43-9	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium (dusts and salts)		NA	NA	NA	NA	NA	NA	NA	NA
Cadmium (fume)	007440-43-9	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium Compounds (as Cd)		NA	6.00E-04	Use MCL	4.00E+01	3.90E+00 [g,i]	1.10E+00 [g,i]	NA [j]	NA [j]
Cadmium Oxide	001306-19-0	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium Stearate	002223-93-0	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	007440-70-2	NA	NA	NA	NA	NA	NA	NA	NA
Calcium Arsenate	007778-44-1	NA	NA	NA	NA	NA	NA	NA	NA
Calcium Cyanamide	000156-62-7	NA	NA	NA	NA	NA	NA	NA	NA
Calcium Stearate	001592-23-0	NA	NA	NA	NA	NA	NA	NA	NA
Camphechlor	008001-35-2	NA	NA	NA	NA	NA	NA	NA	NA
Cantharidin	000056-25-7	NA	NA	NA	NA	NA	NA	NA	NA
Caprolactam (dust)	000105-60-2	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Captan	000133-06-2	NA	NA	NA	NA	NA	NA	NA	NA
Carbachol Chloride	000051-83-2	NA	NA	NA	NA	NA	NA	NA	NA
Carbamic Acid, Methyl, 0-(((2,4-dimethyl-1, 3-dithiolan-2-yl) methylene)amino)-	026419-73-8	NA	NA	NA	NA	NA	NA	NA	NA
Carbaryl	000063-25-2	NA	NA	NA	NA	NA	NA	NA	NA
Carbofuran	001563-66-2	NA	NA	NA	NA	NA	NA	NA	NA
Carbon Disulfide	000075-15-0	NA	NA	4.00E-00	8.00E+03	NA	NA	NA	NA
Carbon Monoxide	000630-08-0	9 ppm (8hr)[w]	NA	NA	NA	NA	NA	NA	NA
Carbon Tetrachloride	000056-23-5	NA	3.00E-02	3.00E-04	5.00E-00	NA	NA	4.40E+00[f]	2.50E-01[f]
Carbonyl Sulfide	000463-58-1	NA	NA	NA	NA	NA	NA	NA	NA
Carbophenothion	000786-19-6	NA	NA	NA	NA	NA	NA	NA	NA
Carene, delta-3-	020296-50-8	NA	NA	NA	NA	NA	NA	NA	NA
Catechol	000120-80-9	NA	NA	NA	NA	NA	NA	NA	NA
Chloracetic Acid	000079-11-8	NA	NA	NA	NA	NA	NA	NA	NA
Chloramben	000133-90-4	NA	NA	NA	NA	NA	NA	NA	NA
Chlordane	000057-74-9	NA	3.00E-03	3.00E-05	5.00E-01	2.40E+00[p]	4.30E-03[p]	5.90E-04[f]	5.70E-04[f]
Chlorfenvinfos	000470-90-6	NA	NA	NA	NA	NA	NA	NA	NA
Chlorine	007782-50-5	NA	NA	NA	NA	NA	NA	NA	NA
Chlormephos	024934-91-6	NA	NA	NA	NA	NA	NA	NA	NA
Chlormequat Chloride	000999-81-5	NA	NA	NA	NA	NA	NA	NA	NA
Chloroacetophenone, 2-	000532-27-4	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	000108-90-7	NA	2.00E+01	7.00E-01	2.00E+03	NA	NA	2.10E+04	6.80E+02
Chlorobenzilate	000510-15-6	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Chloroethanol	000107-07-3	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethyl Chloroformate	000627-11-2	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	000067-66-3	NA	4.00E-02	6.00E-03	1.00E+02	NA	NA	4.70E+02 [f]	5.70E+00 [f]
Chloromethyl Ether	000542-88-1	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethyl Methyl Ether	000107-30-2	NA	NA	NA	NA	NA	NA	NA	NA
Chlorophacinone	003691-35-8	NA	NA	NA	NA	NA	NA	NA	NA
Chloroprene	000126-99-8	NA	NA	NA	NA	NA	NA	NA	NA
Chloropropane, 1,2-dibromo-3-	000096-12-8	NA	NA	NA	NA	NA	NA	NA	NA
Chlorothiophos	021923-23-9	NA	NA	NA	NA	NA	NA	NA	NA
Chloroxuron	001982-47-4	NA	NA	NA	NA	NA	NA	NA	NA
Chromic Chloride	010025-73-7	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	007440-47-3	NA	NA	NA	NA	NA	NA	NA	NA
Chromium Compounds (As Cr) (does not include Cr VI cmpds)		NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	000218-01-9	NA	NA	NA	NA	NA	NA	3.10E-02 [f]	2.80E-03 [f]
Chrysotile	012001-29-5	NA	NA	NA	NA	NA	NA	NA	NA
Coal Tar Pitch Volatiles (as benzene solubles)	065996-93-2	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt Carbonyl	010210-68-1	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt Compounds		NA	NA	NA	NA	NA	NA	NA	NA
Cobalt, ((2,2-(1,2-Ethanediylbis (nitrilo-methylidyne))Bis (6-fluorophenolato))(2-)-NNOO)	062207-76-5	NA	NA	NA	NA	NA	NA	NA	NA
Coke Oven Emissions		NA	NA	NA	NA	NA	NA	NA	NA
Colchicine	000064-86-8	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Copper	007440-50-8	NA	NA	NA	NA	1.80E+01 [g,i]	1.20E+01 [g,i]	NA	NA
Copper (dusts and mists)	007440-50-8	NA	NA	NA	NA	NA	NA	NA	NA
Copper (fume)	007440-50-8	NA	NA	NA	NA	NA	NA	NA	NA
Coumaphos	000056-72-4	NA	NA	NA	NA	NA	NA	NA	NA
Coumatetralyl	005836-29-3	NA	NA	NA	NA	NA	NA	NA	NA
Cresols/Cresylic Acid (isomers and mixture) (cresol)	001319-77-3	NA	NA	NA	NA	NA	NA	NA	NA
Cresols/Cresylic Acid (isomers and mixture) (m-cresol)	000108-39-4	NA	NA	2.00E-00	4.00E+03	NA	NA	NA	NA
Cresols/Cresylic Acid (isomers and mixture) (o-cresol)	000095-48-7	NA	NA	2.00E-00	4.00E+03	NA	NA	NA	NA
Cresols/Cresylic Acid (isomers and mixture) (p-cresol)	000106-44-5	NA	NA	2.00E-00	4.00E+03	NA	NA	NA	NA
Crimidine	000535-89-7	NA	NA	NA	NA	NA	NA	NA	NA
Crocidolite	012001-28-4	NA	NA	NA	NA	NA	NA	NA	NA
Crotonaldehyde	004170-30-3	NA	NA	NA	NA	NA	NA	NA	NA
Crotonaldehyde, (E)-	000123-73-9	NA	NA	NA	NA	NA	NA	NA	NA
Cumene (isopropylbenzene)	000098-82-8	NA	NA	NA	NA	NA	NA	NA	NA
Cyanide Compounds (as free cyanide)		NA	NA	7.00E-01	2.00E+03	2.20E+01	5.20E+00	2.20E+05	7.00E+02
Cyanogen Bromide	000506-68-3	NA	NA	3.00E-00	7.00E+03	NA	NA	NA	NA
Cyanogen Iodide	000506-78-5	NA	NA	NA	NA	NA	NA	NA	NA
Cyanophos	002636-26-2	NA	NA	NA	NA	NA	NA	NA	NA
Cyanuric Fluoride	000675-14-9	NA	NA	NA	NA	NA	NA	NA	NA
Cycloheximide	000066-81-9	NA	NA	NA	NA	NA	NA	NA	NA
Cyclohexylamine	000108-91-8	NA	NA	NA	NA	NA	NA	NA	NA
Cyclopentane	000287-92-3	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS (μg/m³)[c]	RCRA Action Levels[a] Air (μg/m³)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute (μg/L)	Freshwater Life[b,d] Chronic (μg/L)	Human Health[e] Fish (μg/L)	Human Health[e] Fish/Water (μg/L)
Cyclopentene	000142-29-0	NA	NA	NA	NA	NA	NA	NA	NA
DDE	003547-04-4	NA	NA	1.00E-04	2.00E-00	NA	NA	NA	NA
DEHP (Bis(2-ethylhexyl)phthalate)	000117-81-7	NA	NA	3.00E-03	5.00E+01	NA	NA	5.90E+00 [f]	1.80E+00 [f]
Decaborane (14)	017702-41-9	NA	NA	NA	NA	NA	NA	NA	NA
Demeton	008065-48-3	NA	NA	NA	NA	NA	NA	NA	NA
Demeton-S-Methyl	000919-86-8	NA	NA	NA	NA	NA	NA	NA	NA
Dialifor	010311-84-9	NA	NA	NA	NA	NA	NA	NA	NA
Diazomethane	000334-88-3	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	000053-70-3	NA	NA	NA	NA	NA	NA	3.10E-02 [f]	2.80E-03 [f]
Dibenzofuran	000132-64-9	NA	NA	NA	NA	NA	NA	NA	NA
Diborane	019287-45-7	NA	NA	NA	NA	NA	NA	NA	NA
Dibutylphthalate	000084-74-2	NA	NA	4.00E-00	8.00E+03	NA	NA	1.20E+04	2.70E+03
Dichlorobenzene, 1,4- (p)	000106-46-7	NA	NA	NA	NA	NA	NA	2.60E+03	4.00E+02
Dichlorobenzidine, 3,3'-	000091-94-1	NA	NA	8.00E-05	2.00E-00	NA	NA	7.70E-02 [f]	4.00E-02 [f]
Dichlorobutene, Trans-1,4-	000110-57-6	NA	NA	NA	NA	NA	NA	NA	NA
Dichloroethyl Ether (Bis(2-chloroethyl)ether)	000111-44-4	NA	3.00E-03	3.00E-05	6.00E-01	NA	NA	1.40E+00 [f]	3.10E-02 [f]
Dichloromethylphenylsilane	000149-74-6	NA	NA	NA	NA	NA	NA	NA	NA
Dichlorophenoxyacetic Acid, 2,4- (2,4-D) salts and esters	000094-75-7	NA	NA	4.00E-01	8.00E+02	NA	NA	NA	NA
Dichloropropene, 1,3-	000542-75-6	NA	NA	1.00E-02	2.00E+01	NA	NA	1.70E+03	1.00E+01
Dichlorvos (DDVP)	000062-73-7	NA	NA	NA	NA	NA	NA	NA	NA
Dicrotophos (Bidrin)	000141-66-2	NA	NA	NA	NA	NA	NA	NA	NA
Diepoxide		NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Diepoxybutane	001464-53-5	NA	NA	NA	NA	NA	NA	NA	NA
Diethanolamine	000111-42-2	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl Chlorophospate	000814-49-3	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl Phthalate	000084-66-2	NA	NA	3.00E+01	6.00E+04	NA	NA	1.20E+05	2.30E+01
Diethyl Sulfate	000064-67-5	NA	NA	NA	NA	NA	NA	NA	NA
Diethylcarbamazine Citrate	001642-54-2	NA	NA	NA	NA	NA	NA	NA	NA
Diethylenetriamine	000111-40-0	NA	NA	NA	NA	NA	NA	NA	NA
Diethylhexylsebacate		NA	NA	NA	NA	NA	NA	NA	NA
Digitoxin	000071-63-6	NA	NA	NA	NA	NA	NA	NA	NA
Diglycidyl Ether	002238-07-5	NA	NA	NA	NA	NA	NA	NA	NA
Digoxin	020830-75-5	NA	NA	NA	NA	NA	NA	NA	NA
Diisopropylmethylphosphonate	001445-75-6	NA	NA	NA	NA	NA	NA	NA	NA
Dimefox	000115-26-4	NA	NA	NA	NA	NA	NA	NA	NA
Dimethoate	000060-51-5	NA	NA	7.00E-01	2.00E+03	NA	NA	NA	NA
Dimethoxybenzidine, 3,3'-	000119-90-4	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Aminoazobenzene	000060-11-7	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Carbamoyl Chloride	000079-44-7	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Formamide	000068-12-2	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Phosphorochloridothioate	002524-03-0	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Phthalate	000131-11-3	NA	NA	NA	NA	NA	NA	2.90E+06	3.13E+05
Dimethyl Sulfate	000077-78-1	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl-p-Phenylenediamine	000099-98-9	NA	NA	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a]			Freshwater Life[b,d]		Human Health[e]	
			Air ($\mu g/m^3$)	Water (mg/L)	Soil (mg/kg)	Acute ($\mu g/L$)	Chronic ($\mu g/L$)	Fish ($\mu g/L$)	Fish/Water ($\mu g/L$)
Dimethylaniline (N,N-Dimethylaniline)	000121-69-7	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylbenzidine, 3,3'-	000119-93-7	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylbutane, 2,2-	000075-83-2	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylbutane, 2,3-	000079-29-8	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyldichlorosilane	000075-78-5	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylhexane, 2,3-		NA	NA	NA	NA	NA	NA	NA	NA
Dimethylhexane, 2,4-		NA	NA	NA	NA	NA	NA	NA	NA
Dimethylhydrazine	000057-14-7	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylpentane, 2,4-	000108-08-7	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylphenethylamine, alpha, alpha-		NA	NA	NA	NA	NA	NA	NA	NA
Dimetilan	000644-64-4	NA	NA	NA	NA	NA	NA	NA	NA
Dinitro-o-cresol, 4,6- and salts	000534-52-1	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrobenzene, 1,3-	000099-65-0	NA	NA	4.00E-03	8.00E-00	NA	NA	NA	NA
Dinitrobenzenes (all isomers)	025154-54-5	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrocresol	000534-52-1	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrophenol, 2,4-	000051-28-5	NA	NA	7.00E-02	2.00E+02	NA	NA	1.40E+04	7.00E+01
Dinitropyrene, 1,6-	042397-64-8	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrotoluene	025321-14-6	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrotoluene, 2,4-	000121-14-2	NA	NA	NA	NA	NA	NA	9.10E+00[f]	1.10E-01[f]
Dinitrotoluene, 2,6-	000606-20-2	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrotoluene, Mixture		NA	NA	5.00E-05	1.00E+0	NA	NA	NA	NA
Dinoseb	000088-85-7	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	Water (mg/L)	Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Fish/Water ($\mu g/L$)
Dinoterb	001420-07-1	NA	NA	NA	NA	NA	NA	NA	NA
Dioctyl Sebacate	000122-62-3	NA	NA	NA	NA	NA	NA	NA	NA
Dioxane, 1,4- (1,4-Diethyleneoxide)	000123-91-1	NA	NA	3.00E-03	6.00E+01	NA	NA	NA	NA
Dioxathion	000078-34-2	NA	NA	NA	NA	NA	NA	NA	NA
Diphacinone	000082-66-6	NA	NA	NA	NA	NA	NA	NA	NA
Diphenylamine	000122-39-4	NA	NA	9.00E-01	2.00E+03	NA	NA	NA	NA
Diphenylhydrazine, 1,2-	000122-66-7	NA	4.00E-03	4.00E-05	9.00E-01	NA	NA	5.40E-01 [f]	4.00E-02 [f]
Diphenyloxazole, 2,5-	000092-71-7	NA	NA	NA	NA	NA	NA	NA	NA
Diphosphoramide, Octamethyl-	000152-16-9	NA	NA	NA	NA	NA	NA	NA	NA
Disulfoton	000298-04-4	NA	NA	1.00E-03	3.00E-00	NA	NA	NA	NA
Dithiazanine Iodide	000514-73-8	NA	NA	NA	NA	NA	NA	NA	NA
Dithiobiuret	000541-53-7	NA	NA	NA	NA	NA	NA	NA	NA
EPN	002104-64-5	NA	NA	NA	NA	NA	NA	NA	NA
Emetine, Dihydrochloride	000316-42-7	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan	000115-29-7	NA	NA	2.00E-03	4.00E-00	NA	NA	NA	NA
Endothion	002778-04-3	NA	NA	NA	NA	NA	NA	NA	NA
Endrin	000072-20-8	NA	NA	Use MCL	2.00E+01	1.80E-01 [p]	2.30E-03 [p]	8.10E-01	7.60E-01
Epichlorohydrin	000106-89-8	NA	8.00E-01	4.00E-03	7.00E+01	NA	NA	NA	NA
Epoxybutane, 1,2-	000106-88-7	NA	NA	NA	NA	NA	NA	NA	NA
Ergocalciferol	000050-14-6	NA	NA	NA	NA	NA	NA	NA	NA
Ergotamine Tartrate	000379-79-3	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	000074-84-0	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Ethanesulfonyl Chloride, 2-Chloro	001622-32-8	NA	NA	NA	NA	NA	NA	NA	NA
Ethanol, 1,2-Dichloro-, Acetate	010140-87-1	NA	NA	NA	NA	NA	NA	NA	NA
Ethion	000563-12-2	NA	NA	NA	NA	NA	NA	NA	NA
Ethoprophos	013194-48-4	NA	NA	NA	NA	NA	NA	NA	NA
Ethybis(2-Chloroethyl)amine	000538-07-8	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Acrylate	000140-88-5	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Benzene	000100-41-4	NA	NA	4.00E-00	8.00E+03	NA	NA	2.90E+04	3.10E+03
Ethyl Carbamate (Urethane)	000051-79-6	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Chloride (Chloroethane)	000075-00-3	NA	NA	NA	NA	NA	NA	NA	NA
Ethylcyclohexane	001678-91-7	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene	000074-85-1	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene Dibromide (Dibromoethane)	000106-93-4	NA	5.00E-03	4.00E-07	8.00E-03	NA	NA	NA	NA
Ethylene Dichloride (1,2-Dichloroethane)	000107-06-2	NA	4.00E-02	Use MCL	8.00E-00	NA	NA	9.90E+01 [f]	3.80E-01 [f]
Ethylene Fluorohydrin	000371-62-0	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene Glycol	000107-21-1	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene Oxide	000075-21-8	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene Thiourea	000096-45-7	NA	NA	NA	NA	NA	NA	NA	NA
Ethylenediamine	000107-15-3	NA	NA	NA	NA	NA	NA	NA	NA
Ethyleneimine	000151-56-4	NA	NA	NA	NA	NA	NA	NA	NA
Ethylhexane, 3-	000619-99-8	NA	NA	NA	NA	NA	NA	NA	NA
Ethylidene Dichloride (1,1-Dichloroethane)	000075-34-3	NA	NA	NA	NA	NA	NA	NA	NA
Ethylthiocyanate	000542-90-5	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

			RCRA Action Levels[a]			Freshwater Life[b,d]		Human Health[e]	
Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	Air ($\mu g/m^3$)	Water (mg/L)	Soil (mg/kg)	Acute (μg/L)	Chronic (μg/L)	Fish (μg/L)	Fish/Water (μg/L)
Ethyltoluene, 1-		NA	NA	NA	NA	NA	NA	NA	NA
Ethyltoluene, 2-	000611-14-3	NA	NA	NA	NA	NA	NA	NA	NA
Ethyltoluene, 3-	000620-14-4	NA	NA	NA	NA	NA	NA	NA	NA
Fenamiphos	022224-92-6	NA	NA	NA	NA	NA	NA	NA	NA
Fenitrothion	000122-14-5	NA	NA	NA	NA	NA	NA	NA	NA
Fensulfothion	000115-90-2	NA	NA	NA	NA	NA	NA	NA	NA
Fluenetil	004301-50-2	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	000206-44-0	NA	NA	NA	NA	NA	NA	370	300
Fluorene	000086-73-7	NA	NA	NA	NA	NA	NA	1.40E+04	1.30E+03
Fluorine	007782-41-4	NA	NA	NA	NA	NA	NA	NA	NA
Fluoroacetamide	000640-19-7	NA	NA	NA	NA	NA	NA	NA	NA
Fluoroacetic Acid	000144-49-0	NA	NA	NA	NA	NA	NA	NA	NA
Fluoroacetyl Chloride	000359-06-8	NA	NA	NA	NA	NA	NA	NA	NA
Fluorouracil	000051-21-8	NA	NA	NA	NA	NA	NA	NA	NA
Fonofos	000944-22-9	NA	NA	NA	NA	NA	NA	NA	NA
Formaldehyde	000050-00-0	NA	8.00E-02	NA	NA	NA	NA	NA	NA
Formaldehyde Cyanohydrin	000107-16-4	NA	NA	NA	NA	NA	NA	NA	NA
Formetanate Hydrochloride	023422-53-9	NA	NA	NA	NA	NA	NA	NA	NA
Formothion	002540-82-1	NA	NA	NA	NA	NA	NA	NA	NA
Formparanate	017702-57-7	NA	NA	NA	NA	NA	NA	NA	NA
Fosthietan	021548-32-3	NA	NA	NA	NA	NA	NA	NA	NA
Fuberidazole	003878-19-1	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS (µg/m³)[c]	RCRA Action Levels[a] Air (µg/m³)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute (µg/L)	Freshwater Life[b,d] Chronic (µg/L)	Human Health[e] Fish (µg/L)	Human Health[e] Fish/Water (µg/L)
Furan	000110-00-9	NA	NA	NA	NA	NA	NA	NA	NA
Gallium	007440-55-3	NA	NA	NA	NA	NA	NA	NA	NA
Gallium Trichloride	013450-90-3	NA	NA	NA	NA	NA	NA	NA	NA
Germanium	007440-56-4	NA	NA	NA	NA	NA	NA	NA	NA
Glycol Ethers		NA	NA	NA	NA	NA	NA	NA	NA
HMX (Cyclotetramethylene Tetranitramine)	002691-41-0	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	000076-44-8	NA	8.00E-04	8.00E-06	2.00E-01	5.20E-01 [p]	3.80E-03 [p]	2.10E-04 [f]	2.10E-04 [f]
Heptane, n-	000142-82-5	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	000118-74-1	NA	NA	NA	NA	NA	NA	7.70E-04 [f]	7.50E-04 [f]
Hexachlorobutadiene	000087-68-3	NA	4.00E-01	4.00E-03	9.00E+01	NA	NA	5.00E+01 [f]	4.40E-01 [f]
Hexachlorocyclopentadiene	000077-47-4	NA	7.00E-02	2.00E-01	6.00E+02	NA	NA	1.70E+04	2.40E+02
Hexachloroethane	000067-72-1	NA	3.00E-00	3.00E-02	8.00E+01	NA	NA	8.90E+00 [f]	1.90E+00 [f]
Hexamethylene-1,6-diisocyanate	000822-06-0	NA	NA	NA	NA	NA	NA	NA	NA
Hexamethylenediamine, N,N-dibutyl-	004835-11-4	NA	NA	NA	NA	NA	NA	NA	NA
Hexamethylphosphoramide	000680-31-9	NA	NA	NA	NA	NA	NA	NA	NA
Hexane, n-	000110-54-3	NA	NA	NA	NA	NA	NA	NA	NA
Hexene, 1-	000592-41-6	NA	NA	NA	NA	NA	NA	NA	NA
Hexene, cis-2-		NA	NA	NA	NA	NA	NA	NA	NA
Hexene, trans-2-	004050-45-7	NA	NA	NA	NA	NA	NA	NA	NA
Hydrazine	000302-01-2	NA	2.00E-04	1.00E-05	2.00E-01	NA	NA	NA	NA
Hydrochloric Acid or (Hydrogen chloride)	007647-01-0	NA	NA	NA	NA	NA	NA	NA	NA
Hydrocyanic Acid or (Hydrogen cyanide)	000074-90-8	NA	NA	7.00E-01	2.00E+03	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Hydrogen Chloride, Anhydrous	007647-01-0	NA	NA	NA	NA	NA	NA	NA	NA
Hydrogen Fluoride (Hydrofluoric acid)	007664-39-3	NA	NA	NA	NA	NA	NA	NA	NA
Hydrogen Peroxide (saturated)	007722-84-1	NA	NA	NA	NA	NA	NA	NA	NA
Hydrogen Selenide	007783-07-5	NA	NA	NA	NA	NA	NA	NA	NA
Hydrogen Sulfide	007783-06-4	NA	NA	NA	NA	NA	NA	NA	NA
Hydroquinone	000123-31-9	NA	NA	NA	NA	NA	NA	NA	NA
Iodine	007553-56-2	NA	NA	NA	NA	NA	NA	NA	NA
Iron	007439-89-6	NA	NA	NA	NA	NA	NA	NA	NA
Iron (soluble salts)		NA	NA	NA	NA	NA	NA	NA	NA
Iron, Pentacarbonyl-	013463-40-6	NA	NA	NA	NA	NA	NA	NA	NA
Isobenzan	000297-78-9	NA	NA	NA	NA	NA	NA	NA	NA
Isobutyronitrile	000078-82-0	NA	NA	NA	NA	NA	NA	NA	NA
Isocyanic Acid, 3,4-Dichlorophenyl Ester	000102-36-3	NA	NA	NA	NA	NA	NA	NA	NA
Isodrin	000465-73-6	NA	NA	NA	NA	NA	NA	NA	NA
Isofluorphate	000055-91-4	NA	NA	NA	NA	NA	NA	NA	NA
Isophorone	000078-59-1	NA	NA	9.00E-02	2.00E+03	NA	NA	6.00E+02 [f]	8.40E+00 [f]
Isophorone Diisocyanate	004098-71-9	NA	NA	NA	NA	NA	NA	NA	NA
Isoprene	000078-79-5	NA	NA	NA	NA	NA	NA	NA	NA
Isopropyl Chloroformate	000108-23-6	NA	NA	NA	NA	NA	NA	NA	NA
Isopropymethylpyrazolyl Dimethylcarbamate	000119-38-0	NA	NA	NA	NA	NA	NA	NA	NA
Ketone, Bis(Chloromethyl)	000534-07-6	NA	NA	NA	NA	NA	NA	NA	NA
Lactonitrile	000078-97-7	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Lead (Inorganic dusts and fume)		NA	NA	NA	NA	NA	NA	NA	NA
Lead (inorganic)	007439-92-1	1.5[t]	NA	Use MCL	NA	8.20E+01[g,i]	3.20E+00[g,i]	NA[j]	NA[j]
Lead (metal)	007439-92-1	NA	NA	NA	NA	NA	NA	NA	NA
Lead Azide	013424-46-9	NA	NA	NA	NA	NA	NA	NA	NA
Lead Compounds (as Pb)		NA	NA	Use MCL	NA	8.20E+01[g,i]	3.20E+00[g,i]	NA[j]	NA[j]
Lead Styphnate	015245-44-0	NA	NA	NA	NA	NA	NA	NA	NA
Lead, Tetraethyl	000078-00-2	NA	NA	4.00E-06	8.00E-03	NA	NA	NA	NA
Lead, Tetramethyl	000075-74-1	NA	NA	NA	NA	NA	NA	NA	NA
Leptophos	021609-90-5	NA	NA	NA	NA	NA	NA	NA	NA
Lewisite	000541-25-3	NA	NA	NA	NA	NA	NA	NA	NA
Limonene, delta-	005989-27-5	NA	NA	NA	NA	NA	NA	NA	NA
Lindane	000058-89-9	NA	NA	Use MCL	5.00E-01	2.00E+00[p]	8.00E-02[p]	6.30E-02[f]	1.90E-02[f]
Lithium Hydride	007580-67-8	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	007439-95-4	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium Oxide (fume)	001309-48-4	NA	NA	NA	NA	NA	NA	NA	NA
Maleic Anhydride	000108-31-6	NA	NA	4.00E-00	8.00E+03	NA	NA	NA	NA
Malononitrile	000109-77-3	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	007439-96-5	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (Dust and compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Manganese (fume)	007439-96-5	NA	NA	NA	NA	NA	NA	NA	NA
Manganese Compounds (as Mn)		NA	NA	NA	NA	NA	NA	NA	NA
Manganese, Tricarbonyl Methylcyclopentadienyl	012108-13-3	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Mechlorethamine	000051-75-2	NA	NA	NA	NA	NA	NA	NA	NA
Mephosfolan	000950-10-7	NA	NA	NA	NA	NA	NA	NA	NA
Mercuric Acetate	001600-27-7	NA	NA	NA	NA	NA	NA	NA	NA
Mercuric Chloride	007487-94-7	NA	NA	NA	NA	NA	NA	NA	NA
Mercuric Oxide	021908-53-2	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	007439-97-6	NA	NA	NA	NA	2.40E+00	1.20E-02 [h]	1.50E-01	1.40E-01
Mercury (Alkyl compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Mercury (Aryl & inorganic compounds)		NA	NA	Use MCL	2.00E+01	NA	NA	NA	NA
Mercury (Inorganic)		NA	NA	NA	NA	NA	NA	NA	NA
Mercury (vapor)	007439-97-6	NA	NA	NA	NA	NA	NA	NA	NA
Mercury Fulminate	000628-86-4	NA	NA	NA	NA	NA	NA	NA	NA
Methacrolein Diacetate	010476-95-6	NA	NA	NA	NA	NA	NA	NA	NA
Methacrylic Anhydride	000760-93-0	NA	NA	NA	NA	NA	NA	NA	NA
Methacrylonitrile	000126-98-7	NA	7.00E-01	4.00E-03	6.00E-00	NA	NA	NA	NA
Methacryloyl Chloride	000920-46-7	NA	NA	NA	NA	NA	NA	NA	NA
Methacryloyloxyethyl Isocyanate	030674-80-7	NA	NA	NA	NA	NA	NA	NA	NA
Methamidophos	010265-92-6	NA	NA	NA	NA	NA	NA	NA	NA
Methane	000074-82-8	NA	NA	NA	NA	NA	NA	NA	NA
Methanesulfonyl Fluoride	000558-25-8	NA	NA	NA	NA	NA	NA	NA	NA
Methanol	000067-56-1	NA	NA	NA	NA	NA	NA	NA	NA
Methidathion	000950-37-8	NA	NA	NA	NA	NA	NA	NA	NA
Methiocarb	002032-65-7	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Methicarb	001129-41-5	NA	NA	NA	NA	NA	NA	NA	NA
Methomyl	016752-77-5	NA	NA	9.00E-01	2.00E+03	NA	NA	NA	NA
Methoxychlor	000072-43-5	NA	NA	NA	NA	NA	NA	NA	NA
Methoxyethylmercuric Acetate	000151-38-2	NA	NA	NA	NA	NA	NA	NA	NA
Methyl 2-Chloroacrylate	000080-63-7	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Bromide (Bromomethane)	000074-83-9	NA	3.00E+01	5.00E-02	1.00E+02	NA	NA	4.00E+03	4.80E+01
Methyl Chloride (Chloromethane)	000074-87-3	NA	NA	NA	NA	NA	NA	NA[j]	NA[j]
Methyl Chloroformate	000079-22-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Ethyl Ketone (2-Butanone)	000078-93-3	NA	3.00E+02	2.00E-00	4.00E+03	NA	NA	NA	NA
Methyl Hydrazine	000060-34-4	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Iodide (Iodomethane)	000074-88-4	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone (Hexone)	000108-10-1	NA	7.00E+01	2.00E-00	4.00E+03	NA	NA	NA	NA
Methyl Isocyanate	000624-83-9	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isothiocyanate	000556-61-6	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Mercaptan	000074-93-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Methacrylate	000080-62-6	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Phenkapton	003735-23-7	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Phosphonic Dichloride	000676-97-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Tert Butyl Ether	001634-04-4	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Thiocyanate	000556-64-9	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Vinyl Ketone	000078-94-4	NA	NA	NA	NA	NA	NA	NA	NA
Methyl chloroform (1,1,1-Trichloroethane)	000071-55-6	NA	1.00E+03	3.00E-00	7.00E+03	NA	NA	NA[j]	NA[j]

Revision Date: 04/06/95

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Methyl-1-Butene, 2-	000563-46-2	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-1-Butene, 3-	000563-45-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-1-Pentene, 2-	000763-29-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-1-Pentene, 4-	000691-37-2	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-2-Butene, 2-	000513-35-9	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-2-Pentene, 2-	000625-27-4	NA	NA	NA	NA	NA	NA	NA	NA
Methylcyclohexane	000108-87-2	NA	NA	NA	NA	NA	NA	NA	NA
Methylcyclopentane	000096-37-7	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride (Dichloromethane)	000075-09-2	NA	3.00E-01	5.00E-03	9.00E+01	NA	NA	1.60E+03 [f]	4.70E+00 [f]
Methylene Diphenyl Diisocyanate (MDI)	000101-68-8	NA	NA	NA	NA	NA	NA	NA	NA
Methylene bis(2-chloroaniline), 4,4'-	000101-14-4	NA	NA	NA	NA	NA	NA	NA	NA
Methylenedianiline, 4,4'-	000101-77-9	NA	NA	NA	NA	NA	NA	NA	NA
Methylheptane, 2-		NA	NA	NA	NA	NA	NA	NA	NA
Methylhexane, 3-	000589-34-4	NA	NA	NA	NA	NA	NA	NA	NA
Methylhydantoin, 5-Ethyl-1,3-diglycidyl-5-	000592-27-8	NA	NA	NA	NA	NA	NA	NA	NA
Methylmercuric Dicyanamide	000502-39-6	NA	NA	NA	NA	NA	NA	NA	NA
Methylnaphthalene, 2-	000091-57-6	NA	NA	NA	NA	NA	NA	NA	NA
Methylpentane, 2-	000107-83-5	NA	NA	NA	NA	NA	NA	NA	NA
Methylpentane, 3-	000096-14-0	NA	NA	NA	NA	NA	NA	NA	NA
Methyltrichlorosilane	000075-79-6	NA	NA	NA	NA	NA	NA	NA	NA
Methytlnaphthalene, 1-	001321-94-4	NA	NA	NA	NA	NA	NA	NA	NA
Mevinphos (Phosdrin)	007786-34-7	NA	NA	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Mexacarbate	000315-18-4	NA	NA	NA	NA	NA	NA	NA	NA
Mineral fibers		NA	NA	NA	NA	NA	NA	NA	NA
Mitomycin C	000050-07-7	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum	007439-98-7	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum (Insoluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum (Soluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Monocrotophos	006923-22-4	NA	NA	NA	NA	NA	NA	NA	NA
Monoethylamine (Ethylamine)	000075-04-7	NA	NA	NA	NA	NA	NA	NA	NA
Muscimol	002763-94-4	NA	NA	NA	NA	NA	NA	NA	NA
Mustard Gas	000505-60-2	NA	NA	NA	NA	NA	NA	NA	NA
Myrcene	000123-35-3	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	000091-20-3	NA	NA	NA	NA	NA	NA	NA	NA
Naphthaleneamine, 2-		NA	NA	NA	NA	NA	NA	NA	NA
Naphthylamine, 2-	000091-59-8	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	007440-02-0	NA	NA	7.00E-01	2.00E+03	1.40E+03[g,i]	1.60E+02[g,i]	4.60E+03	6.10E+02
Nickel (Metal)	007440-02-0	NA	NA	7.00E-01	2.00E+03	1.40E+03[g,i]	1.60E+02[g,i]	4.60E+03	6.10E+02
Nickel (Refinery dust)	007440-02-0	NA	NA	NA	NA	NA	NA	NA	NA
Nickel (Soluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Nickel (Soluble salts)		NA	NA	NA	NA	NA	NA	NA	NA
Nickel Carbonyl	013463-39-3	NA	NA	NA	NA	NA	NA	NA	NA
Nicotine	000054-11-5	NA	NA	NA	NA	NA	NA	NA	NA
Nicotine Sulfate	000065-30-5	NA	NA	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute (μg/L)	Freshwater Life[b,d] Chronic (μg/L)	Human Health[e] Fish (μg/L)	Human Health[e] Fish/Water (μg/L)
Nitric Acid	007697-37-2	NA	NA	NA	NA	NA	NA	NA	NA
Nitric Oxide	010102-43-9	NA	NA	4.00E-00	8.00E+03	NA	NA	NA	NA
Nitrobenzene	000098-95-3	NA	2.00E-00	2.00E-02	4.00E+01	NA	NA	1.90E+03	1.70+01
Nitrobiphenyl, 4- (or 4-Nitrodiphenyl)	000092-93-3	NA	NA	NA	NA	NA	NA	NA	NA
Nitrocellulose	009004-70-0	NA	NA	NA	NA	NA	NA	NA	NA
Nitrocyclohexane	001122-60-7	NA	NA	NA	NA	NA	NA	NA	NA
Nitrodiphenylamine, 2-	000199-75-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitrodiphenylamine, 4-	000836-30-6	NA	NA	NA	NA	NA	NA	NA	NA
Nitrogen Dioxide	010102-44-0	0.053 ppm[a]	NA	4.00E+01	8.00E+04	NA	NA	NA	NA
Nitroglycerine	000055-63-0	NA	NA	NA	NA	NA	NA	NA	NA
Nitroguanidine	000556-88-7	NA	NA	NA	NA	NA	NA	NA	NA
Nitromethane	000075-52-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitronaphthalene, 2-	000581-89-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitrophenol, 4-	000100-02-7	NA	NA	NA	NA	NA	NA	NA	NA
Nitrophenol, o-	000088-75-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitropropane, 2-	000079-46-9	NA	NA	NA	NA	NA	NA	NA	NA
Nitropyrene, 1-		NA	NA	NA	NA	NA	NA	NA	NA
Nitroso-N-methylurea, N-	000684-93-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitrosochethylamine, N-		NA	NA	NA	NA	NA	NA	NA	NA
Nitrosodimethylamine, N-	000062-75-9	NA	7.00E-05	7.00E-07	1.00E-02	NA	NA	8.10E+00[f]	6.90E-04[f]
Nitrosodiphenylamine, 4-	000156-10-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitrosodiphenylamine, N-	000086-30-6	NA	NA	7.00E-03	1.00E+02	NA	NA	1.60E+01[f]	5.00E+00[f]

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Nitrosomorpholine, N-	000059-89-2	NA	NA	NA	NA	NA	NA	NA	NA
Nonane, n-	000111-84-2	NA	NA	NA	NA	NA	NA	NA	NA
Norbormide	000991-42-4	NA	NA	NA	NA	NA	NA	NA	NA
Octane, n-	000111-65-9	NA	NA	NA	NA	NA	NA	NA	NA
Organorthodium Complex (PMN-92-147)		NA	NA	NA	NA	NA	NA	NA	NA
Ouabain	000630-60-4	NA	NA	NA	NA	NA	NA	NA	NA
Oxamyl	023135-22-0	NA	NA	NA	NA	NA	NA	NA	NA
Oxetane, 3,3-Bis(chloromethyl)-	000078-71-7	NA	NA	NA	NA	NA	NA	NA	NA
Oxydisulfoton	002497-07-6	NA	NA	NA	NA	NA	NA	NA	NA
Ozone	010028-15-6	0.12 ppm[v]	NA	NA	NA	NA	NA	NA	NA
Paraquat	004685-14-7	NA	NA	NA	NA	NA	NA	NA	NA
Paraquat Methosulfate	002074-50-2	NA	NA	NA	NA	NA	NA	NA	NA
Parathion	000056-38-2	NA	NA	2.00E-01	5.00E+02	NA	NA	NA	NA
Parathion, Methyl	000298-00-0	NA	NA	NA	NA	NA	NA	NA	NA
Paris Green	012002-03-8	NA	NA	NA	NA	NA	NA	NA	NA
Particulates (PM10)		150 (24hr)	NA	NA	NA	NA	NA	NA	NA
Particulates (PM10, total dust)		150 (24hr)	NA	NA	NA	NA	NA	NA	NA
Pentaborane	019624-22-7	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloronitrobenzene (Quintobenzene)	000082-68-8	NA	1.00E-01	1.00E-01	2.00E+02	NA	NA	NA	NA
Pentachlorophenol	000087-86-5	NA	NA	1.00E-00	2.00E+03	2.00E+01[m]	1.30E+01[m]	8.20E+00[f]	2.80E-01[f]
Pentadecylamine	002570-26-5	NA	NA	NA	NA	NA	NA	NA	NA
Pentaerythritol Tetranitrate (PETN)	000078-11-5	NA	NA	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Pentene	025377-72-4	NA	NA	NA	NA	NA	NA	NA	NA
Pentene, 1-	000109-67-1	NA	NA	NA	NA	NA	NA	NA	NA
Pentene, cis-2-	000627-20-3	NA	NA	NA	NA	NA	NA	NA	NA
Pentene, trans-2-	000646-04-8	NA	NA	NA	NA	NA	NA	NA	NA
Peracetic Acid	000079-21-0	NA	NA	NA	NA	NA	NA	NA	NA
Perchloromethylmercaptan	000594-42-3	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	000085-01-8	NA	NA	NA	NA	NA	NA	NA	NA
Phenol	000108-95-2	NA	NA	2.00E+01	5.00E+04	NA	NA	4.60E+06	2.10E+04
Phenol, 2,2 Thiobis(4-chloro-6-methyl)-	004418-66-0	NA	NA	NA	NA	NA	NA	NA	NA
Phenol, 3-(1 Methylethyl)-, Methylcarbamate	000064-00-6	NA	NA	NA	NA	NA	NA	NA	NA
Phenoxarsine, 10, 10-Oxydi-	000058-36-6	NA	NA	NA	NA	NA	NA	NA	NA
Phenyl Dichloroarsine	000696-28-6	NA	NA	NA	NA	NA	NA	NA	NA
Phenyldiisodecyl Phosphite		NA	NA	NA	NA	NA	NA	NA	NA
Phenylenediamine, p	000106-50-3	NA	NA	NA	NA	NA	NA	NA	NA
Phenylhydrazine Hydrochloride	000059-88-1	NA	NA	NA	NA	NA	NA	NA	NA
Phenylmercury Acetate	000062-38-4	NA	NA	3.00E-03	6.00E-00	NA	NA	NA	NA
Phenylsilatrane	002097-19-0	NA	NA	NA	NA	NA	NA	NA	NA
Phenylthiourea	000103-85-5	NA	NA	NA	NA	NA	NA	NA	NA
Phorate	000298-02-2	NA	NA	NA	NA	NA	NA	NA	NA
Phosacetim	004104-14-7	NA	NA	NA	NA	NA	NA	NA	NA
Phosfolan	000947-02-4	NA	NA	NA	NA	NA	NA	NA	NA
Phosgene	000075-44-5	NA	NA	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a]			Freshwater Life[b,d]		Human Health[e]	
			Air ($\mu g/m^3$)	Water (mg/L)	Soil (mg/kg)	Acute ($\mu g/L$)	Chronic ($\mu g/L$)	Fish ($\mu g/L$)	Fish/Water ($\mu g/L$)
Phosmet	000732-11-6	NA	NA	NA	NA	NA	NA	NA	NA
Phosphamidon	013171-21-6	NA	NA	NA	NA	NA	NA	NA	NA
Phosphine	007803-51-2	NA	NA	1.00E-02	2.00E+01	NA	NA	NA	NA
Phosphonothioic Acid, Methyl-, O-(4-nitrophenyl) O-phenyl ester	002665-30-7	NA	NA	NA	NA	NA	NA	NA	NA
Phosphonothioic Acid, Methyl-, O-ethyl O-(4-(methylthio)phenyl) ester	002703-13-1	NA	NA	NA	NA	NA	NA	NA	NA
Phosphonothioic Acid, Methyl-, S-(2-(Bis(1-methylethyl)amino)ethyl O-ethyl ester	050782-69-9	NA	NA	NA	NA	NA	NA	NA	NA
Phosphoric Acid, Dimethyl 4-(methylthio) phenyl ester	003254-63-5	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorothioic Acid, O,O-Dimethyl-S-(2-methylthio)ethyl ester	002587-90-8	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus	007723-14-0	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus (white, yellow)	007723-14-0	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus Oxychloride	010025-87-3	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus Pentachloride	010026-13-8	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus Pentoxide	001314-56-3	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus Trichloride	007719-12-2	NA	NA	NA	NA	NA	NA	NA	NA
Phthalic Anhydride	000085-44-9	NA	NA	7.00E+01	2.00E+05	NA	NA	NA	NA
Physostigmine	000057-47-6	NA	NA	NA	NA	NA	NA	NA	NA
Physotigmine, Salicylate (1:1)	000057-64-7	NA	NA	NA	NA	NA	NA	NA	NA
Picric acid	000088-89-1	NA	NA	NA	NA	NA	NA	NA	NA
Picrotoxin	000124-87-8	NA	NA	NA	NA	NA	NA	NA	NA
Pinene, alpha-	000080-56-8	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Propyl Adipate, di-N-	000106-19-4	NA	NA	NA	NA	NA	NA	NA	NA
Propyl Chloroformate	000109-61-5	NA	NA	NA	NA	NA	NA	NA	NA
Propylbenzene, 1-	000103-65-1	NA	NA	NA	NA	NA	NA	NA	NA
Propylene Dichloride (1,2-Dichloropropane)	000078-87-5	NA	NA	NA	NA	NA	NA	NA	NA
Propylene Oxide	000075-56-9	NA	NA	NA	NA	NA	NA	NA	NA
Propyleneimine	000075-55-8	NA	NA	NA	NA	NA	NA	NA	NA
Prothoate	002275-18-5	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	000129-00-0	NA	NA	NA	NA	NA	NA	1.10E+04	9.60E+02
Pyridine, 2-Methyl-5-Vinyl-	000140-76-1	NA	NA	NA	NA	NA	NA	NA	NA
Pyridine, 4-Amino-	000504-24-5	NA	NA	NA	NA	NA	NA	NA	NA
Pyridine, 4-Nitro-, 1-Oxide	001124-33-0	NA	NA	NA	NA	NA	NA	NA	NA
Pyriminil	053558-25-1	NA	NA	NA	NA	NA	NA	NA	NA
Quinoline	000091-22-5	NA	NA	NA	NA	NA	NA	NA	NA
Quinone	000106-51-4	NA	NA	NA	NA	NA	NA	NA	NA
RDX (Cyclo-1,3,5-trimethylene-2,4,6-trinitramine)	000121-82-4	NA	NA	NA	NA	NA	NA	NA	NA
Radionuclides (Includes radon, See entries for specific compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Resorcinol	000108-46-3	NA	NA	NA	NA	NA	NA	NA	NA
Salane, (4-Aminobutyl)diethoxymethyl-	003037-72-7	NA	NA	NA	NA	NA	NA	NA	NA
Salcomine	014167-18-1	NA	NA	NA	NA	NA	NA	NA	NA
Salicylic Acid	000069-72-7	NA	NA	NA	NA	NA	NA	NA	NA
Sarin	000107-44-8	NA	NA	NA	NA	NA	NA	NA	NA
Selenious Acid	007783-00-8	NA	NA	1.00E-01	2.00E+02	NA	NA	NA	NA

			RCRA Action Levels[a]			Freshwater Life[b,d]		Human Health[e]	
Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	Air ($\mu g/m^3$)	Water (mg/L)	Soil (mg/kg)	Acute ($\mu g/L$)	Chronic ($\mu g/L$)	Fish ($\mu g/L$)	Fish/Water ($\mu g/L$)
Pinene, beta-	000127-91-3	NA	NA	NA	NA	NA	NA	NA	NA
Piperidine	000110-89-4	NA	NA	NA	NA	NA	NA	NA	NA
Pirimifos, Ethyl	023505-41-1	NA	NA	NA	NA	NA	NA	NA	NA
Polychlorinated Biphenyls (Aroclors)	001336-36-3	NA	NA	5.00E-06	9.00E-02	NA	NA	NA	NA
Polycylic Organic Matter		NA	NA	NA	NA	NA	NA	NA	NA
Polystyrene	009003-53-6	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	007440-09-7	NA	NA	NA	NA	NA	NA	NA	NA
Potassium Arsenide	010124-50-2	NA	NA	NA	NA	NA	NA	NA	NA
Potassium Cyanide	000151-50-8	NA	NA	2.00E-00	4.00E+03	NA	NA	NA	NA
Potassium Hydroxide	001310-58-3	NA	NA	NA	NA	NA	NA	NA	NA
Potassium Nitrate	007757-79-1	NA	NA	NA	NA	NA	NA	NA	NA
Potassium Silver Cyanide	000506-61-6	NA	NA	7.00E-00	2.00E+04	NA	NA	NA	NA
Promecarb	002631-37-0	NA	NA	NA	NA	NA	NA	NA	NA
Propane	000074-98-6	NA	NA	NA	NA	NA	NA	NA	NA
Propane Sultone, 1,3-	001120-71-4	NA	NA	NA	NA	NA	NA	NA	NA
Propargyl Bromide	000106-96-7	NA	NA	NA	NA	NA	NA	NA	NA
Propiolactone, Beta-	000057-57-8	NA	NA	NA	NA	NA	NA	NA	NA
Propionaldehyde	000123-38-6	NA	NA	NA	NA	NA	NA	NA	NA
Propionitrile	000107-12-0	NA	NA	NA	NA	NA	NA	NA	NA
Propionitrile, 3-Chloro-	000542-76-7	NA	NA	NA	NA	NA	NA	NA	NA
Propiophenone, 4-Amino-	000070-69-9	NA	NA	NA	NA	NA	NA	NA	NA
Propoxur (Baygon)	000114-26-1	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	Water (mg/L)	Soil (mg/kg)	Freshwater Life[b,d] Acute (μg/L)	Chronic (μg/L)	Human Health[e] Fish (μg/L)	Fish/Water (μg/L)
Selenium	007782-49-2	NA	NA	NA	NA	2.00E+01	5.00E+00	NA[j]	NA[j]
Selenium Compounds (as Se)		NA	NA	NA	NA	2.00E+01	5.00E+00	NA[j]	NA[j]
Selenium Oxychloride	007791-23-3	NA	NA	NA	NA	NA	NA	NA	NA
Semicarbazide Hydrochloride	000563-41-7	NA	NA	NA	NA	NA	NA	NA	NA
Silane, Trichloro(chloromethyl)-	001558-25-4	NA	NA	NA	NA	NA	NA	NA	NA
Silane, Trichloro(dichloropheny)-	027137-85-5	NA	NA	NA	NA	NA	NA	NA	NA
Silicon	007440-21-3	NA	NA	NA	NA	NA	NA	NA	NA
Silicon (Total dust)	007440-21-3	NA	NA	NA	NA	NA	NA	NA	NA
Silver (Metal dust and fume)	007440-22-4	NA	NA	NA	NA	NA	NA	NA	NA
Silver (Metal dust and soluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Silver (Metal dust, soluble compounds, and fumes)		NA	NA	NA	NA	NA	NA	NA	NA
Silver (Soluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Silver (metal)	007440-22-4	NA	NA	Use MCL	2.00E+02	4.10E+00[g,i]	NA	NA	NA
Sodium Arsenate	007631-89-2	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Arsenite	007784-46-5	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Azide	026628-22-8	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Cacodylate	000124-65-2	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Cyanide	000143-33-9	NA	NA	1.00E-00	3.00E+03	NA	NA	NA	NA
Sodium Fluoroacetate	000062-74-8	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Nitrate	007631-99-4	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Selenate	013410-01-0	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Selenite	010102-18-8	NA	NA	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Sodium Tellurite	010102-20-2	NA	NA	NA	NA	NA	NA	NA	NA
Stannane, Acetoxytriphenyl-	000900-95-8	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	007440-24-6	NA	NA	NA	NA	NA	NA	NA	NA
Strychnine	000057-24-9	NA	NA	1.00E-02	2.00E+01	NA	NA	NA	NA
Strychnine Sulfate	000060-41-3	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	000100-42-5	NA	NA	7.00E-00	2.00E+04	NA	NA	NA	NA
Styrene Oxide	000096-09-3	NA	NA	NA	NA	NA	NA	NA	NA
Sulfotep (Tetraethyldithiopyrophosphate or TEDP)	003689-24-5	NA	NA	NA	NA	NA	NA	NA	NA
Sulfoxide, 3-Chloropropyl octyl	003569-57-1	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur	007704-34-9	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur Dioxide	007446-09-5	0.14 ppm (24hr)	NA	NA	NA	NA	NA	NA	NA
Sulfur Dioxide, Anhydrous		NA	NA	NA	NA	NA	NA	NA	NA
Sulfur Tetrafluoride	007783-60-0	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur Trioxide	007446-11-9	365 (24hr)[v]	NA	NA	NA	NA	NA	NA	NA
Sulfuric Acid	007664-93-9	NA	NA	NA	NA	NA	NA	NA	NA
TEPP	000107-49-3	NA	NA	NA	NA	NA	NA	NA	NA
Tabun	000077-81-6	NA	NA	NA	NA	NA	NA	NA	NA
Tellurium	013494-80-9	NA	NA	NA	NA	NA	NA	NA	NA
Tellurium Hexafluoride	007783-80-4	NA	NA	NA	NA	NA	NA	NA	NA
Terbufos	013071-79-9	NA	NA	NA	NA	NA	NA	NA	NA
Terpinene, alpha-	000099-86-5	NA	NA	NA	NA	NA	NA	NA	NA
Terpinene, delta-		NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Water (mg/L)	RCRA Soil (mg/kg)	Freshwater Life[b,d] Acute (µg/L)	Freshwater Life Chronic (µg/L)	Human Health[e] Fish (µg/L)	Human Health Fish/Water (µg/L)
Terpinolene	000586-62-9	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	001746-01-6	NA	NA	NA	NA	NA	NA	1.40E-08 [f]	1.30E-08 [f]
Tetrachloroethane, 1,1,2,2-	000079-34-5	NA	2.00E-01	2.00E-03	4.00E+01	NA	NA	1.10E+01 [f]	1.70E-01 [f]
Tetrachloroethylene (Perchloroethylene)	000127-18-4	NA	1.00E-00	7.00E-04	1.00E+01	NA	NA	8.85E+00 [f]	8.00E-01 [f]
Tetranitromethane	000509-14-8	NA	NA	NA	NA	NA	NA	NA	NA
Tetryl (Trinitro-2,4-6-phenylmethylnitramine)	000479-45-8	NA	NA	NA	NA	NA	NA	NA	NA
Thallium Sulfate	010031-59-1	NA	NA	3.00E-03	6.00E-00	NA	NA	NA	NA
Thallous Carbonate	006533-73-9	NA	NA	NA	NA	NA	NA	NA	NA
Thallous Chloride	007791-12-0	NA	NA	NA	NA	NA	NA	NA	NA
Thallous Malonate	002757-18-8	NA	NA	NA	NA	NA	NA	NA	NA
Thallous Sulfate	007446-18-6	NA	NA	NA	NA	NA	NA	NA	NA
Thiocarbazide	002231-57-4	NA	NA	NA	NA	NA	NA	NA	NA
Thiofanox	039196-18-4	NA	NA	NA	NA	NA	NA	NA	NA
Thionazin	000297-97-2	NA	NA	NA	NA	NA	NA	NA	NA
Thiophenol	000108-98-5	NA	NA	NA	NA	NA	NA	NA	NA
Thiosemicarbazide	000079-19-6	NA	NA	2.00E-01	5.00E+02	NA	NA	NA	NA
Thiourea, (2-Chlorophenyl)-	005344-82-1	NA	NA	NA	NA	NA	NA	NA	NA
Thiourea, (2-Methylphenyl)-	000614-78-8	NA	NA	NA	NA	NA	NA	NA	NA
Tin (Metal)	007440-31-5	NA	NA	NA	NA	NA	NA	NA	NA
Tin (Organic compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Tin (Oxide and inorganic compounds except SnH4)		NA	NA	NA	NA	NA	NA	NA	NA
Tin (and compounds)		NA	NA	NA	NA	NA	NA	NA	NA

Revision Date: 04/06/95

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Action Levels[a] Water (mg/L)	RCRA Action Levels[a] Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Life[b,d] Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health[e] Fish/Water ($\mu g/L$)
Tin (inorganic compounds except oxides)	007440-31-5	NA	NA	NA	NA	NA	NA	NA	NA
Tin, Tetraethyl	000597-64-8	NA	NA	NA	NA	NA	NA	NA	NA
Titanium	007440-32-6	NA	NA	NA	NA	NA	NA	NA	NA
Titanium Tetrachloride	007550-45-0	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	000108-88-3	NA	7.00E+03	1.00E+01	2.00E+04	NA	NA	2.00E+05	6.80E+03
Toluene 2,6-Diisocyanate	000091-08-7	NA	NA	NA	NA	NA	NA	NA	NA
Toluene Diamine, 2,4-	000095-80-7	NA	NA	NA	NA	NA	NA	NA	NA
Toluene Diisocyanate	026471-62-5	NA	NA	NA	NA	NA	NA	NA	NA
Toluene, 2,4-Diisocyanate	000584-84-9	NA	NA	NA	NA	NA	NA	NA	NA
Toluidine, o-	000095-53-4	NA	NA	NA	NA	NA	NA	NA	NA
Toxaphene (Chlorinated camphene)	008001-35-2	NA	3.00E-03	Use MCL	6.00E-01	7.30E-01	2.00E-04	7.50E-04 [f]	7.30E-04 [f]
Triacetin	000102-76-1	NA	NA	NA	NA	NA	NA	NA	NA
Triamiphos	001031-47-6	NA	NA	NA	NA	NA	NA	NA	NA
Triazofos	024017-47-8	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroacetyl Chloride	000076-02-8	NA	NA	NA	NA	NA	NA	NA	NA
Trichlorobenzene, 1,2,4-	000120-82-1	NA	1.00E+01	7.00E-01	2.00E+03	NA	NA	NA	NA
Trichloroethane, 1,1,2-	000079-00-5	NA	6.00E-01	6.00E-03	1.00E+02	NA	NA	4.20E+01 [f]	6.00E-01 [f]
Trichloroethylene	000079-01-6	NA	NA	Use MCL	6.00E+01	NA	NA	8.10E+01 [f]	2.70E+00 [f]
Trichloroethylsilane	000115-21-9	NA	NA	NA	NA	NA	NA	NA	NA
Trichloronate	000327-98-0	NA	NA	NA	NA	NA	NA	NA	NA
Trichlorophenol, 2,4,5-	000095-95-4	NA	NA	4.00E-00	8.00E+03	NA	NA	NA	NA
Trichlorophenol, 2,4,6-	000088-06-2	NA	2.00E-01	2.00E-03	4.00E+01	NA	NA	6.50E+00 [f]	2.10E+00 [f]

Revision Date: 04/06/95

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	RCRA Water (mg/L)	RCRA Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Freshwater Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Human Health Fish/Water ($\mu g/L$)
Trichlorophenylsilane	000098-13-5	NA	NA	NA	NA	NA	NA	NA	NA
Triethoxysilane	000998-30-1	NA	NA	NA	NA	NA	NA	NA	NA
Triethylamine	000121-44-8	NA	NA	NA	NA	NA	NA	NA	NA
Trifluralin	001582-09-8	NA	NA	NA	NA	NA	NA	NA	NA
Trimethyl-3-phenylindane, 1,1,3-	003910-35-8	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylbenzene, 1,2,4-	000095-63-6	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylbenzene, 1,3,5-	000108-67-8	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylchlorosilane	000075-77-4	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylolpropane Phosphite	000824-11-3	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylpentane, 2,2,3-	054665-47-3	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylpentane, 2,2,4-	000540-84-1	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylpentane, 2,3,4-	000565-75-3	NA	NA	NA	NA	NA	NA	NA	NA
Trimethyltin Chloride	001066-45-1	NA	NA	NA	NA	NA	NA	NA	NA
Trinitroanisole	028653-16-9	NA	NA	NA	NA	NA	NA	NA	NA
Trinitrobenzene, 1,3,5-	000099-35-4	NA	NA	NA	NA	NA	NA	NA	NA
Trinitroglycerol	000055-63-0	NA	NA	NA	NA	NA	NA	NA	NA
Trinitrotoluene, 2,4,6-	000118-96-7	NA	NA	NA	NA	NA	NA	NA	NA
Triphenyltin Chloride	000639-58-7	NA	NA	NA	NA	NA	NA	NA	NA
Tris(2-Chloroethyl) Amine	000555-77-1	NA	NA	NA	NA	NA	NA	NA	NA
Uranium	007440-61-1	NA	NA	NA	NA	NA	NA	NA	NA
Uranium (Insoluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Uranium (Natural)	007440-61-1	NA	NA	NA	NA	NA	NA	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

			RCRA Action Levels[a]			Freshwater Life[b,d]		Human Health[e]	
Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	Air ($\mu g/m^3$)	Water (mg/L)	Soil (mg/kg)	Acute ($\mu g/L$)	Chronic ($\mu g/L$)	Fish ($\mu g/L$)	Fish/Water ($\mu g/L$)
Uranium (Soluble and insoluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Uranium (Soluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Uranium Soluble Salts		NA	NA	NA	NA	NA	NA	NA	NA
Valinomycin	002001-95-8	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	007440-62-2	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium Pentoxide (as V2O5)	001314-62-1	NA	NA	3.00E-01	7.00E+02	NA	NA	NA	NA
Vinyl Acetate	000108-05-4	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Bromide	000593-60-2	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	000075-01-4	NA	NA	NA	NA	NA	NA	5.25E+02 [f]	2.00E+00 [f]
Vinylidene Chloride (1,1-Dichloroethylene)	000075-35-4	NA	3.00E-02	Use MCL	1.00E+01	NA	NA	3.20E+00 [f]	5.70E-02 [f]
Warfarin	000081-81-2	NA	NA	NA	NA	NA	NA	NA	NA
Warfarin, Sodium	000129-06-6	NA	NA	NA	NA	NA	NA	NA	NA
Xylene (all isomers)	001330-20-7	NA	1.00E+03 [r]	7.00E+01 [r]	2.00E+05 [r]	NA	NA	NA	NA
Xylene Dichloride	028347-13-9	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, m-	000108-38-3	NA	1.00E+03 [r]	7.00E+01 [r]	2.00E+05 [r]	NA	NA	NA	NA
Xylene, o-	000095-47-6	NA	1.00E+03 [r]	7.00E+01 [r]	2.00E+05 [r]	NA	NA	NA	NA
Xylene, p-	000106-42-3	NA	1.00E+03 [r]	7.00E+01 [r]	2.00E+05 [r]	NA	NA	NA	NA
Xylenes (isomers and mixture)	001330-20-7	NA	1.00E+03 [r]	7.00E+01 [r]	2.00E+05 [r]	NA	NA	NA	NA
Xylenes (isomers and mixture) -m	000108-38-3	NA	1.00E+03 [r]	7.00E+01 [r]	2.00E+05 [r]	NA	NA	NA	NA
Xylenes (isomers and mixture) -o	000095-47-6	NA	1.00E+03 [r]	7.00E+01 [r]	2.00E+05 [r]	NA	NA	NA	NA
Xylenes (isomers and mixture) -p	000106-42-3	NA	1.00E+03 [r]	7.00E+01 [r]	2.00E+05 [r]	NA	NA	NA	NA
Zinc (metallic)	007440-66-6	NA	NA	NA	NA	1.20E+02 [g,i]	1.10E+02 [g,i]	NA	NA

ENVIRONMENTAL STANDARDS AND CRITERIA

Chemical	CAS Number	NAAQS ($\mu g/m^3$)[c]	RCRA Action Levels[a] Air ($\mu g/m^3$)	Water (mg/L)	Soil (mg/kg)	Freshwater Life[b,d] Acute ($\mu g/L$)	Chronic ($\mu g/L$)	Human Health[e] Fish ($\mu g/L$)	Fish/Water ($\mu g/L$)
Zinc Oxide (dust)	001314-13-2	NA	NA	NA	NA	NA	NA	NA	NA
Zinc Oxide (fume)	001314-13-2	NA	NA	NA	NA	NA	NA	NA	NA
Zinc Phosphide	001314-84-7	NA	NA	1.00E-02	2.00E+01	NA	NA	NA	NA
Zinc, Dichloro(4,4-dimethyl-5(((methylamino) carbonyl)oxy)imino)pentanenitrile)-(T-4)	058270-08-9	NA	NA	NA	NA	NA	NA	NA	NA
Zirconium (and compounds)		NA	NA	NA	NA	NA	NA	NA	NA

NA = Not available

[a] Values taken from proposed rule for Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities (55 FR 30798, July 27, 1990) under Section 3004 (U) of RCRA. Action Levels were calculated based on RfD current at that time; if RfD has changed, action level needs to be recalculated using formula given in the proposed rule. Final rule expected October 1994.

[b] AWQC = Ambient Water Quality Criteria, Clean Water Act, 57 FR 60848, December 22, 1992.

[c] NAAQS = Clean Air Act, National Ambient Air Quality Standards (40 CFR 50.4, 50.6, 50.8, and 50.9-50.12). Hourly values represent the maximum concentration not to be exceeded more than once per year.

[d] AWQC for the protection of aquatic organisms. Acute values represent 1 hour average concentrations not to be exceeded more than once every three years. Chronic values represent four day average concentrations not to be exceeded more than once every three years.

[e] AWQC for the protection of humans for the consumption of fish alone or for the consumption of fish and drinking water.

[f] Criteria based on carcinogenicity (10^{-6} risk).

[g] Expressed as a function of total hardness (100 mg/L as $CaCO_3$).

[h] If the Criteria Continuous Concentration CCC for ambient water total mercury exceeds 0.012 $\mu g/L$ more than once in a 3-year period, the edible portion of aquatic species must be analyzed to determine determine if the concentration of methyl mercury exceeds the FDA action level of 1.0 mg/kg.

[i] Expressed as a function of the water effect ratio as defined in 40 CFR 131.36(c).

[j] EPA is not promulgating human health criteria for this compound, but permit authorities should address this contaminant in NPDES permit actions using the states's existing narrative criteria for toxics.

[k] Fibers/L

[m] Freshwater aquatic life criteria for pentachlorophenol are expresses as a function of pH, and are calculated as follows. Values displayed above in the matrix correspond to a pH of 7.8

CMC = exp(1.005(pH) - 4.830) CCC = exp(1.005(pH) - 5.9290)

[p] Aquatic life criteria for these compunds were issued in 1980 utilizing the 1980 Guidelines for criteria development. The acute values shown are final acute values (FAV) which by the 1980 Guidelines are instantaneous values as contrasted with a CMC which is a one-hour average.

[r] Value is for total xylenes

[s] Annual arithmetic mean concentration.

[t] Three-month maximum arithmetic mean concentration.

[u] Annual geometric mean.

[v] Maximum hourly average concentration not to be exceeded more than once per year.

[w] Average concentration .

[x] Annual arithmetic mean for sulfur dioxide is 0.03 ppm.

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
ANTU	000086-88-4	NA	NA	NA	NA	NA	NA	NA	NA
Acetaldehyde	000075-07-0	NA	NA	NA	NA	NA	NA	NA	NA
Acetamide	000060-35-5	NA	NA	NA	NA	NA	NA	NA	NA
Acetone Cyanohydrin	000075-86-5	NA	NA	NA	NA	NA	NA	NA	NA
Acetone Thiosemicarbazide	001752-30-3	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	000075-05-8	NA	NA	NA	NA	NA	NA	NA	NA
Acetophenone	000098-86-2	NA	NA	NA	NA	NA	NA	NA	NA
Acetylaminofluorene, 2-	000053-96-3	NA	NA	NA	NA	NA	NA	NA	NA
Acetylene	000074-86-2	NA	NA	NA	NA	NA	NA	NA	NA
Acrolein	000107-02-8	NA	NA	NA	NA	NA	NA	NA	NA
Acrylamide	000079-06-1	zero	TT	1.5	0.3	0.002	0.02	0.07	NA
Acrylic Acid	000079-10-7	NA	NA	NA	NA	NA	NA	NA	NA
Acrylonitrile	000107-13-1	NA	NA	NA	NA	NA	NA	NA	NA
Acrylyl Chloride	000814-68-6	NA	NA	NA	NA	NA	NA	NA	NA
Adiponitrile	000111-69-3	NA	NA	NA	NA	NA	NA	NA	NA
Aldicarb	000116-06-3	0.001	0.003	NA	NA	NA	NA	0.035 [g]	0.007 [g]
Aldrin	000309-00-2	NA	NA	0.0003 [g]	0.0003 [g]	0.0003 [g]	0.0003 [g]	0.001 [g]	NA
Allyl Alcohol	000107-18-6	NA	NA	NA	NA	NA	NA	NA	NA
Allyl Chloride	000107-05-1	NA	NA	NA	NA	NA	NA	NA	NA
Allylamine	000107-11-9	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum	007429-90-5	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum (alkyls)		NA	NA	NA	NA	NA	NA	NA	NA
Aluminum (metal dust, respirable fraction)	007429-90-5	NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Aluminum (pyro powders)		NA	NA	NA	NA	NA	NA	NA	NA
Aluminum (soluble salts)		NA	NA	NA	NA	NA	NA	NA	NA
Aluminum (welding fume)	007429-90-5	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum Phosphide	020859-73-8	NA	NA	NA	NA	NA	NA	NA	NA
Aminobiphenyl, 4-	000092-67-1	NA	NA	NA	NA	NA	NA	NA	NA
Aminopterin	000054-62-6	NA	NA	NA	NA	NA	NA	NA	NA
Amiton	000078-53-5	NA	NA	NA	NA	NA	NA	NA	NA
Amiton Oxalate	003734-97-2	NA	NA	NA	NA	NA	NA	NA	NA
Ammonia	007664-41-7	NA	NA	NA	NA	NA	NA	NA	30
Ammonium Nitrate	006484-52-2	NA	NA	NA	NA	NA	NA	NA	NA
Ammonium Picrate	000131-74-8	NA	NA	NA	NA	NA	NA	NA	NA
Amosite	012172-73-5	7[d]	7[d]	NA	NA	NA	NA	NA	NA
Amphetamine	000300-62-9	NA	NA	NA	NA	NA	NA	NA	NA
Aniline	000062-53-3	NA	NA	NA	NA	NA	NA	NA	NA
Aniline, 2,4,6-Trimethyl-	000088-05-1	NA	NA	NA	NA	NA	NA	NA	NA
Anisidine, o-	000090-04-0	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	000120-12-7	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	007440-36-0	0.006	0.006	0.01	0.01	0.01	0.015	0.01	0.003
Antimony Compounds (as Sb)		0.006	0.006	0.01	0.01	0.01	0.015	0.01	0.003
Antimony Pentafluoride	007783-70-2	NA	NA	NA	NA	NA	NA	NA	NA
Antimycin A	001397-94-0	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	007440-38-2	NA	0.05	NA	NA	NA	NA	NA	NA
Arsenic (inorganic compounds)		NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Arsenic (Organic compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Arsenic Pentoxide	001303-28-2	NA	NA	NA	NA	NA	NA	NA	NA
Arsenous Oxide	001327-53-3	NA	NA	NA	NA	NA	NA	NA	NA
Arsenous Trichloride	007784-34-1	NA	NA	NA	NA	NA	NA	NA	NA
Arsine	007784-42-1	NA	NA	NA	NA	NA	NA	NA	NA
Asbestos	001332-21-4	7[d,e]	7[d,e]	NA	NA	NA	NA	NA	NA
Azinphos-Ethyl	002642-71-9	NA	NA	NA	NA	NA	NA	NA	NA
Azinphos-Methyl	000086-50-0	NA	NA	NA	NA	NA	NA	NA	NA
Barium	007440-39-3	2	2	NA	NA	NA	NA	2	2
Barium (Soluble compounds)		2	2	NA	NA	NA	NA	NA	NA
Barium Nitrate	010022-31-8	NA	NA	NA	NA	NA	NA	NA	NA
Benzal Chloride	000098-87-3	NA	NA	NA	NA	NA	NA	NA	NA
Benzenamine, 3-(Trifluoromethyl)	000098-16-8	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	000071-43-2	zero	0.005	0.2	0.2	NA	NA	NA	NA
Benzene, 1-(Chloromethyl)-4-nitro-	000100-14-1	NA	NA	NA	NA	NA	NA	NA	NA
Benzenearsonic Acid	000098-05-5	NA	NA	NA	NA	NA	NA	NA	NA
Benzidine	000092-87-5	NA	NA	NA	NA	NA	NA	NA	NA
Benzimidazole, 4,5-Dichloro-2-(trifluoromethyl)	003615-21-2	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	000056-55-3	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene (also see Coal Tar Pitch Volatiles)	000050-32-8	zero	0.0002	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	000205-99-2	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(c)acridine		NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	000207-08-9	NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Carbofuran	001563-66-2	0.04	0.04	0.05	0.05	0.05	0.2	0.2	0.04
Carbon Disulfide	000075-15-0	NA	NA	NA	NA	NA	NA	NA	NA
Carbon Monoxide	000630-08-0	NA	NA	NA	NA	NA	NA	NA	NA
Carbon Tetrachloride	000056-23-5	zero	0.005	4	0.2	0.07	0.3	0.03	NA
Carbonyl Sulfide	000463-58-1	NA	NA	NA	NA	NA	NA	NA	NA
Carbophenothion	000786-19-6	NA	NA	NA	NA	NA	NA	NA	NA
Carene, delta-3-	020296-50-8	NA	NA	NA	NA	NA	NA	NA	NA
Catechol	000120-80-9	NA	NA	NA	NA	NA	NA	NA	NA
Chloracetic Acid	000079-11-8	NA	NA	NA	NA	NA	NA	NA	NA
Chloramben	000133-90-4	NA	NA	3	3	0.2	0.5	0.5	0.1
Chlordane	000057-74-9	zero	0.002	0.06	0.06	NA	NA	0.002	NA
Chlorfenvinfos	000470-90-6	NA	NA	NA	NA	NA	NA	NA	NA
Chlorine	007782-50-5	NA	NA	NA	NA	NA	NA	NA	NA
Chlormephos	024934-91-6	NA	NA	NA	NA	NA	NA	NA	NA
Chlormequat Chloride	000999-81-5	NA	NA	NA	NA	NA	NA	NA	NA
Chloroacetophenone, 2-	000532-27-4	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	000108-90-7	0.1	0.1	2	2	2	7	0.7	0.1
Chlorobenzilate	000510-15-6	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethanol	000107-07-3	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethyl Chloroformate	000627-11-2	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	000067-66-3	NA	NA	4 [g]	4 [g]	0.1 [g]	0.4 [g]	0.4 [g]	NA
Chloromethyl Ether	000542-88-1	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethyl Methyl Ether	000107-30-2	NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Chlorophacinone	003691-35-8	NA	NA	NA	NA	NA	NA	NA	NA
Chloroprene	000126-99-8	NA	NA	NA	NA	NA	NA	NA	NA
Chloropropane, 1,2-dibromo-3-	000096-12-8	zero	0.0002	0.2	0.05	NA	NA	NA	NA
Chlorothiophos	021923-23-9	NA	NA	NA	NA	NA	NA	NA	NA
Chloroxuron	001982-47-4	NA	NA	NA	NA	NA	NA	NA	NA
Chromic Chloride	010025-73-7	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	007440-47-3	0.1	0.1	1	1	0.2	0.8	0.2	0.1
Chromium Compounds (As Cr) (does not include Cr VI cmpds)		0.1	0.1	1	1	0.2	0.8	0.2	0.1
Chrysene	000218-01-9	NA	NA	NA	NA	NA	NA	NA	NA
Chrysotile	012001-29-5	7[d]	7[d]	NA	NA	NA	NA	NA	NA
Coal Tar Pitch Volatiles (as benzene solubles)	065996-93-2	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt Carbonyl	010210-68-1	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt Compounds		NA	NA	NA	NA	NA	NA	NA	NA
Cobalt, ((2,2-(1,2-Ethanediylbis (nitrilo-methylidyne))Bis (6-fluorophenolato))(2-)-NNOO)	062207-76-5	NA	NA	NA	NA	NA	NA	NA	NA
Coke Oven Emissions		NA	NA	NA	NA	NA	NA	NA	NA
Colchicine	000064-86-8	NA	NA	NA	NA	NA	NA	NA	NA
Copper	007440-50-8	1.3	1.3 AL	NA	NA	NA	NA	NA	NA
Copper (dusts and mists)	007440-50-8	NA	NA	NA	NA	NA	NA	NA	NA
Copper (fume)	007440-50-8	1.3	1.3 AL	NA	NA	NA	NA	NA	NA
Coumaphos	000056-72-4	NA	NA	NA	NA	NA	NA	NA	NA
Coumatetralyl	005836-29-3	NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Cresols/Cresylic Acid (isomers and mixture) (cresol)	001319-77-3	NA	NA	NA	NA	NA	NA	NA	NA
Cresols/Cresylic Acid (isomers and mixture) (m-cresol)	000108-39-4	NA	NA	NA	NA	NA	NA	NA	NA
Cresols/Cresylic Acid (isomers and mixture) (o-cresol)	000095-48-7	NA	NA	NA	NA	NA	NA	NA	NA
Cresols/Cresylic Acid (isomers and mixture) (p-cresol)	000106-44-5	NA	NA	NA	NA	NA	NA	NA	NA
Crimidine	000535-89-7	NA	NA	NA	NA	NA	NA	NA	NA
Crocidolite	012001-28-4	7[d]	7[d]	NA	NA	NA	NA	NA	NA
Crotonaldehyde	004170-30-3	NA	NA	NA	NA	NA	NA	NA	NA
Crotonaldehyde, (E)-	000123-73-9	NA	NA	NA	NA	NA	NA	NA	NA
Cumene (Isopropylbenzene)	000098-82-8	NA	NA	NA	NA	NA	NA	NA	NA
Cyanide Compounds (as free cyanide)		0.2	0.2	0.2	0.2	0.2	0.8	0.8	0.2
Cyanogen Bromide	000506-68-3	NA	NA	NA	NA	NA	NA	NA	NA
Cyanogen Iodide	000506-78-5	NA	NA	NA	NA	NA	NA	NA	NA
Cyanophos	002636-26-2	NA	NA	NA	NA	NA	NA	NA	NA
Cyanuric Fluoride	000675-14-9	NA	NA	NA	NA	NA	NA	NA	NA
Cycloheximide	000066-81-9	NA	NA	NA	NA	NA	NA	NA	NA
Cyclohexylamine	000108-91-8	NA	NA	NA	NA	NA	NA	NA	NA
Cyclopentane	000287-92-3	NA	NA	NA	NA	NA	NA	NA	NA
Cyclopentene	000142-29-0	NA	NA	NA	NA	NA	NA	NA	NA
DDE	003547-04-4	NA	NA	NA	NA	NA	NA	NA	NA
DEHP (Bis(2-ethylhexyl)phthalate)	000117-81-7	zero	0.006	NA	NA	NA	NA	0.7	NA
Decaborane (14)	017702-41-9	NA	NA	NA	NA	NA	NA	NA	NA
Demeton	008065-48-3	NA	NA	NA	NA	NA	NA	NA	NA
Demeton-S-Methyl	000919-86-8	NA	NA	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Dialifor	010311-84-9	NA	NA	NA	NA	NA	NA	NA	NA
Diazomethane	000334-88-3	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	000053-70-3	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	000132-64-9	NA	NA	NA	NA	NA	NA	NA	NA
Diborane	019287-45-7	NA	NA	NA	NA	NA	NA	NA	NA
Dibutylphthalate	000084-74-2	NA	NA	NA	NA	NA	NA	4	NA
Dichlorobenzene, 1,4- (p)	000106-46-7	0.075	0.075	10	10	10	40	4	0.075
Dichlorobenzidine, 3,3'-	000091-94-1	NA	NA	NA	NA	NA	NA	NA	NA
Dichlorobutene, Trans-1,4-	000110-57-6	NA	NA	NA	NA	NA	NA	NA	NA
Dichloroethyl Ether (Bis(2-chloroethyl)ether)	000111-44-4	NA	NA	NA	NA	NA	NA	NA	NA
Dichloromethylphenylsilane	000149-74-6	NA	NA	NA	NA	NA	NA	NA	NA
Dichlorophenoxyacetic Acid, 2,4- (2,4-D) salts and esters	000094-75-7	0.07	0.07	1	0.3	0.1	0.4	0.4	0.07
Dichloropropene, 1,3-	000542-75-6	NA	NA	0.03	0.03	0.03	0.09	0.01	NA
Dichlorvos (DDVP)	000062-73-7	NA	NA	NA	NA	NA	NA	NA	NA
Dicrotophos (Bidrin)	000141-66-2	NA	NA	NA	NA	NA	NA	NA	NA
Diepoxide		NA	NA	NA	NA	NA	NA	NA	NA
Diepoxybutane	001464-53-5	NA	NA	NA	NA	NA	NA	NA	NA
Diethanolamine	000111-42-2	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl Chlorophospate	000814-49-3	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl Phthalate	000084-66-2	NA	NA	NA	NA	NA	NA	30	5
Diethyl Sulfate	000064-67-5	NA	NA	NA	NA	NA	NA	NA	NA
Diethylcarbamazine Citrate	001642-54-2	NA	NA	NA	NA	NA	NA	NA	NA
Diethylenetriamine	000111-40-0	NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Diethylhexylsebacate		NA	NA	NA	NA	NA	NA	NA	NA
Digitoxin	000071-63-6	NA	NA	NA	NA	NA	NA	NA	NA
Diglycidyl Ether	002238-07-5	NA	NA	NA	NA	NA	NA	NA	NA
Digoxin	020830-75-5	NA	NA	NA	NA	NA	NA	NA	NA
Diisopropylmethylphosphonate	001445-75-6	NA	NA	8	8	8	30	3	0.6
Dimefox	000115-26-4	NA	NA	NA	NA	NA	NA	NA	NA
Dimethoate	000060-51-5	NA	NA	NA	NA	NA	NA	NA	NA
Dimethoxybenzidine, 3,3'-	000119-90-4	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Aminoazobenzene	000060-11-7	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Carbamoyl Chloride	000079-44-7	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Formamide	000068-12-2	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Phosphorochloridothioate	002524-03-0	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Phthalate	000131-11-3	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Sulfate	000077-78-1	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl-p-Phenylenediamine	000099-98-9	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylaniline (N,N-Dimethylaniline)	000121-69-7	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylbenzidine, 3,3'-	000119-93-7	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylbutane, 2,2-	000075-83-2	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylbutane, 2,3-	000079-29-8	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyldichlorosilane	000075-78-5	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylhexane, 2,3-		NA	NA	NA	NA	NA	NA	NA	NA
Dimethylhexane, 2,4-		NA	NA	NA	NA	NA	NA	NA	NA
Dimethylhydrazine	000057-14-7	NA	NA	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Dimethylpentane, 2,4-	000108-08-7	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylphenethylamine, alpha, alpha-		NA	NA	NA	NA	NA	NA	NA	NA
Dimetilan	000644-64-4	NA	NA	NA	NA	NA	NA	NA	NA
Dinitro-o-cresol, 4,6- and salts	000534-52-1	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrobenzene, 1,3-	000099-65-0	NA	NA	0.04	0.04	0.04	0.14	0.005	0.001
Dinitrobenzenes (all isomers)	025154-54-5	NA	NA	0.04	0.04	0.04	0.14	0.005	0.001
Dinitrocresol	000534-52-1	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrophenol, 2,4-	000051-28-5	NA	NA	NA	NA	NA	NA	NA	NA
Dinitropyrene, 1,6-	042397-64-8	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrotoluene	025321-14-6	NA	NA	NA	NA	NA	NA	NA	NA
Dinitrotoluene, 2,4-	000121-14-2	NA	NA	0.5	0.5	0.3	1	0.1	NA
Dinitrotoluene, 2,6-	000606-20-2	NA	NA	0.40	0.40	0.40	1	0.04	NA
Dinitrotoluene, Mixture		NA	NA	NA	NA	NA	NA	NA	NA
Dinoseb	000088-85-7	0.007	0.007	0.3	0.3	0.01	0.04	0.04	0.007
Dinoterb	001420-07-1	NA	NA	NA	NA	NA	NA	NA	NA
Dioctyl Sebacate	000122-62-3	NA	NA	NA	NA	NA	NA	NA	NA
Dioxane, 1,4- (1,4-Diethyleneoxide)	000123-91-1	NA	NA	4	0.4	NA	NA	NA	NA
Dioxathion	000078-34-2	NA	NA	NA	NA	NA	NA	NA	NA
Diphacinone	000082-66-6	NA	NA	NA	NA	NA	NA	NA	NA
Diphenylamine	000122-39-4	NA	NA	1	1	0.3	1	1	0.2
Diphenylhydrazine, 1,2-	000122-66-7	NA	NA	NA	NA	NA	NA	NA	NA
Diphenyloxazole, 2,5-	000092-71-7	NA	NA	NA	NA	NA	NA	NA	NA
Diphosphoramide, Octamethyl-	000152-16-9	NA	NA	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child			70-kg Adult		
				One Day (mg/L)	Ten Day (mg/L)	Long Term (mg/L)	Long Term (mg/L)	DWEL (mg/L)	Lifetime (mg/L)
Disulfoton	000298-04-4	NA	NA	0.01	0.01	0.003	0.009	0.001	0.0003
Dithiazanine Iodide	000514-73-8	NA	NA	NA	NA	NA	NA	NA	NA
Dithiobiuret	000541-53-7	NA	NA	NA	NA	NA	NA	NA	NA
EPN	002104-64-5	NA	NA	NA	NA	NA	NA	NA	NA
Emetine, Dihydrochloride	000316-42-7	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan	000115-29-7	NA	NA	NA	NA	NA	NA	NA	NA
Endothion	002778-04-3	NA	NA	NA	NA	NA	NA	NA	NA
Endrin	000072-20-8	0.002	0.002	0.02	0.02	0.003	0.01	0.01	0.002
Epichlorohydrin	000106-89-8	zero	TT	0.1	0.1	0.07	0.07	0.07	NA
Epoxybutane, 1,2-	000106-88-7	NA	NA	NA	NA	NA	NA	NA	NA
Ergocalciferol	000050-14-6	NA	NA	NA	NA	NA	NA	NA	NA
Ergotamine Tartrate	000379-79-3	NA	NA	NA	NA	NA	NA	NA	NA
Ethane	000074-84-0	NA	NA	NA	NA	NA	NA	NA	NA
Ethanesulfonyl Chloride, 2-Chloro	001622-32-8	NA	NA	NA	NA	NA	NA	NA	NA
Ethanol, 1,2-Dichloro-, Acetate	010140-87-1	NA	NA	NA	NA	NA	NA	NA	NA
Ethion	000563-12-2	NA	NA	NA	NA	NA	NA	NA	NA
Ethoprophos	013194-48-4	NA	NA	NA	NA	NA	NA	NA	NA
Ethybis(2-Chloroethyl)amine	000538-07-8	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Acrylate	000140-88-5	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Benzene	000100-41-4	0.7	0.7	30	3	1	3	3	0.7
Ethyl Carbamate (Urethane)	000051-79-6	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Chloride (Chloroethane)	000075-00-3	NA	NA	NA	NA	NA	NA	NA	NA
Ethylcyclohexane	001678-91-7	NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Ethylene	000074-85-1	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene Dibromide (Dibromoethane)	000106-93-4	zero	0.00005	0.008	0.008	NA	NA	NA	NA
Ethylene Dichloride (1,2-Dichloroethane)	000107-06-2	zero	0.005	0.7	0.7	0.7	2.6	NA	NA
Ethylene Fluorohydrin	000371-62-0	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene Glycol	000107-21-1	NA	NA	20	6	6	20	40	7
Ethylene Oxide	000075-21-8	NA	NA	NA	NA	NA	NA	NA	NA
Ethylene Thiourea	000096-45-7	NA	NA	0.3	0.3	0.1	0.4	0.003	NA
Ethylenediamine	000107-15-3	NA	NA	NA	NA	NA	NA	NA	NA
Ethyleneimine	000151-56-4	NA	NA	NA	NA	NA	NA	NA	NA
Ethylhexane, 3-	000619-99-8	NA	NA	NA	NA	NA	NA	NA	NA
Ethylidene Dichloride (1,1-Dichloroethane)	000075-34-3	0.007	0.007	NA	NA	NA	NA	NA	NA
Ethylthiocyanate	000542-90-5	NA	NA	NA	NA	NA	NA	NA	NA
Ethyltoluene, 1-		NA	NA	NA	NA	NA	NA	NA	NA
Ethyltoluene, 2-	000611-14-3	NA	NA	NA	NA	NA	NA	NA	NA
Ethyltoluene, 3-	000620-14-4	NA	NA	NA	NA	NA	NA	NA	NA
Fenamiphos	022224-92-6	NA	NA	0.009	0.009	0.005	0.02	0.009	0.002
Fenitrothion	000122-14-5	NA	NA	NA	NA	NA	NA	NA	NA
Fensulfothion	000115-90-2	NA	NA	NA	NA	NA	NA	NA	NA
Fluenetil	004301-50-2	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	000206-44-0	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	000086-73-7	NA	NA	NA	NA	NA	NA	NA	NA
Fluorine	007782-41-4	NA	NA	NA	NA	NA	NA	NA	NA
Fluoroacetamide	000640-19-7	NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Fluoroacetic Acid	000144-49-0	NA	NA	NA	NA	NA	NA	NA	NA
Fluoroacetyl Chloride	000359-06-8	NA	NA	NA	NA	NA	NA	NA	NA
Fluorouracil	000051-21-8	NA	NA	NA	NA	NA	NA	NA	NA
Fonofos	000944-22-9	NA	NA	0.02	0.02	0.02	0.07	0.07	0.01
Formaldehyde	000050-00-0	NA	NA	10 [g]	5 [g]	5 [g]	20 [g]	5 [g]	1 [g]
Formaldehyde Cyanohydrin	000107-16-4	NA	NA	NA	NA	NA	NA	NA	NA
Formetanate Hydrochloride	023422-53-9	NA	NA	NA	NA	NA	NA	NA	NA
Formothion	002540-82-1	NA	NA	NA	NA	NA	NA	NA	NA
Formparanate	017702-57-7	NA	NA	NA	NA	NA	NA	NA	NA
Fosthietan	021548-32-3	NA	NA	NA	NA	NA	NA	NA	NA
Fuberidazole	003878-19-1	NA	NA	NA	NA	NA	NA	NA	NA
Furan	000110-00-9	NA	NA	NA	NA	NA	NA	NA	NA
Gallium	007440-55-3	NA	NA	NA	NA	NA	NA	NA	NA
Gallium Trichloride	013450-90-3	NA	NA	NA	NA	NA	NA	NA	NA
Germanium	007440-56-4	NA	NA	NA	NA	NA	NA	NA	NA
Glycol Ethers		NA	NA	NA	NA	NA	NA	NA	NA
HMX (Cyclotetramethylene Tetranitramine)	002691-41-0	NA	NA	5	5	5	20	2	0.4
Heptachlor	000076-44-8	zero	0.0004	0.01	0.01	0.005	0.005	0.02	NA
Heptane, n-	000142-82-5	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	000118-74-1	zero	0.001	0.05	0.05	0.05	0.2	0.03	NA
Hexachlorobutadiene	000087-68-3	NA	NA	0.3	0.3	0.1	0.4	0.07	0.001
Hexachlorocyclopentadiene	000077-47-4	0.05	0.05	NA	NA	NA	NA	0.2	NA
Hexachloroethane	000067-72-1	NA	NA	5	5	0.1	0.5	0.04	0.001

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Hexamethylene-1,6-diisocyanate	000822-06-0	NA	NA	NA	NA	NA	NA	NA	NA
Hexamethylenediamine, N,N-dibutyl-	004835-11-4	NA	NA	NA	NA	NA	NA	NA	NA
Hexamethylphosphoramide	000680-31-9	NA	NA	NA	NA	NA	NA	NA	NA
Hexane, n-	000110-54-3	NA	NA	10	4	4	10	NA	NA
Hexene, 1-	000592-41-6	NA	NA	NA	NA	NA	NA	NA	NA
Hexene, cis-2-		NA	NA	NA	NA	NA	NA	NA	NA
Hexene, trans-2-	004050-45-7	NA	NA	NA	NA	NA	NA	NA	NA
Hydrazine	000302-01-2	NA	NA	NA	NA	NA	NA	NA	NA
Hydrochloric Acid or (Hydrogen chloride)	007647-01-0	NA	NA	NA	NA	NA	NA	NA	NA
Hydrocyanic Acid or (Hydrogen cyanide)	000074-90-8	NA	NA	0.2	0.2	0.2	0.8	0.8	0.2
Hydrogen Chloride, Anhydrous	007647-01-0	NA	NA	NA	NA	NA	NA	NA	NA
Hydrogen Fluoride (Hydrofluoric acid)	007664-39-3	NA	NA	NA	NA	NA	NA	NA	NA
Hydrogen Peroxide (saturated)	007722-84-1	NA	NA	NA	NA	NA	NA	NA	NA
Hydrogen Selenide	007783-07-5	NA	NA	NA	NA	NA	NA	NA	NA
Hydrogen Sulfide	007783-06-4	NA	NA	NA	NA	NA	NA	NA	NA
Hydroquinone	000123-31-9	NA	NA	NA	NA	NA	NA	NA	NA
Iodine	007553-56-2	NA	NA	NA	NA	NA	NA	NA	NA
Iron	007439-89-6	NA	NA	NA	NA	NA	NA	NA	NA
Iron (soluble salts)		NA	NA	NA	NA	NA	NA	NA	NA
Iron, Pentacarbonyl-	013463-40-6	NA	NA	NA	NA	NA	NA	NA	NA
Isobenzan	000297-78-9	NA	NA	NA	NA	NA	NA	NA	NA
Isobutyronitrile	000078-82-0	NA	NA	NA	NA	NA	NA	NA	NA
Isocyanic Acid, 3,4-Dichlorophenyl Ester	000102-36-3	NA	NA	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Isodrin	000465-73-6	NA	NA	NA	NA	NA	NA	NA	NA
Isofluorphate	000055-91-4	NA	NA	NA	NA	NA	NA	NA	NA
Isophorone	000078-59-1	NA	NA	15	15	15	15	7	0.1
Isophorone Diisocyanate	004098-71-9	NA	NA	NA	NA	NA	NA	NA	NA
Isoprene	000078-79-5	NA	NA	NA	NA	NA	NA	NA	NA
Isopropyl Chloroformate	000108-23-6	NA	NA	NA	NA	NA	NA	NA	NA
Isopropymethylpyrazolyl Dimethylcarbamate	000119-38-0	NA	NA	NA	NA	NA	NA	NA	NA
Ketone, Bis(Chloromethyl)	000534-07-6	NA	NA	NA	NA	NA	NA	NA	NA
Lactonitrile	000078-97-7	NA	NA	NA	NA	NA	NA	NA	NA
Lead (Inorganic dusts and fume)		NA	NA	NA	NA	NA	NA	NA	NA
Lead (inorganic)	007439-92-1	zero	0.015 AL	NA	NA	NA	NA	NA	NA
Lead (metal)	007439-92-1	zero	0.015 AL	NA	NA	NA	NA	NA	NA
Lead Azide	013424-46-9	NA	NA	NA	NA	NA	NA	NA	NA
Lead Compounds (as Pb)		NA	NA	NA	NA	NA	NA	NA	NA
Lead Styphnate	015245-44-0	NA	NA	NA	NA	NA	NA	NA	NA
Lead, Tetraethyl	000078-00-2	NA	NA	NA	NA	NA	NA	NA	NA
Lead, Tetramethyl	000075-74-1	NA	NA	NA	NA	NA	NA	NA	NA
Leptophos	021609-90-5	NA	NA	NA	NA	NA	NA	NA	NA
Lewisite	000541-25-3	NA	NA	NA	NA	NA	NA	NA	NA
Limonene, delta-	005989-27-5	NA	NA	NA	NA	NA	NA	NA	NA
Lindane	000058-89-9	0.0002	0.0002	1	1	0.03	0.1	0.01	0.0002
Lithium Hydride	007580-67-8	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	007439-95-4	NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Magnesium Oxide (fume)	001309-48-4	NA	NA	NA	NA	NA	NA	NA	NA
Maleic Anhydride	000108-31-6	NA	NA	NA	NA	NA	NA	NA	NA
Malononitrile	000109-77-3	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	007439-96-5	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (Dust and compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Manganese (fume)	007439-96-5	NA	NA	NA	NA	NA	NA	NA	NA
Manganese Compounds (as Mn)		NA	NA	NA	NA	NA	NA	NA	NA
Manganese, Tricarbonyl Methylcyclopentadienyl	012108-13-3	NA	NA	NA	NA	NA	NA	NA	NA
Mechlorethamine	000051-75-2	NA	NA	NA	NA	NA	NA	NA	NA
Mephosfolan	000950-10-7	NA	NA	NA	NA	NA	NA	NA	NA
Mercuric Acetate	001600-27-7	NA	NA	NA	NA	NA	NA	NA	NA
Mercuric Chloride	007487-94-7	NA	NA	NA	NA	NA	NA	NA	NA
Mercuric Oxide	021908-53-2	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	007439-97-6	0.002	0.002	NA	NA	NA	0.002	0.01	0.002
Mercury (Alkyl compounds)		0.002	0.002	NA	NA	NA	NA	NA	NA
Mercury (Aryl & Inorganic compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Mercury (Inorganic)		0.002	0.002	NA	NA	NA	0.002	0.01	0.002
Mercury (vapor)	007439-97-6	NA	NA	NA	NA	NA	0.002	0.01	0.002
Mercury Fulminate	000628-86-4	NA	NA	NA	NA	NA	NA	NA	NA
Methacrolein Diacetate	010476-95-6	NA	NA	NA	NA	NA	NA	NA	NA
Methacrylic Anhydride	000760-93-0	NA	NA	NA	NA	NA	NA	NA	NA
Methacrylonitrile	000126-98-7	NA	NA	NA	NA	NA	NA	NA	NA
Methacryloyl Chloride	000920-46-7	NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Methacryloyloxyethyl Isocyanate	030674-80-7	NA	NA	NA	NA	NA	NA	NA	NA
Methamidophos	010265-92-6	NA	NA	NA	NA	NA	NA	NA	NA
Methane	000074-82-8	NA	NA	NA	NA	NA	NA	NA	NA
Methanesulfonyl Fluoride	000558-25-8	NA	NA	NA	NA	NA	NA	NA	NA
Methanol	000067-56-1	NA	NA	NA	NA	NA	NA	NA	NA
Methidathion	000950-37-8	NA	NA	NA	NA	NA	NA	NA	NA
Methiocarb	002032-65-7	NA	NA	NA	NA	NA	NA	NA	NA
Methicarb	001129-41-5	NA	NA	NA	NA	NA	NA	NA	NA
Methomyl	016752-77-5	NA	NA	0.3	0.3	0.3	0.3	0.9	0.2
Methoxychlor	000072-43-5	0.04	0.04	0.05	0.05	0.05	0.2	0.2	0.04
Methoxyethylmercuric Acetate	000151-38-2	NA	NA	NA	NA	NA	NA	NA	NA
Methyl 2-Chloroacrylate	000080-63-7	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Bromide (Bromomethane)	000074-83-9	NA	NA	0.1	0.1	0.1	0.5	0.04	0.01
Methyl Chloride (Chloromethane)	000074-87-3	NA	NA	9	0.4	0.4	1	0.1	0.003
Methyl Chloroformate	000079-22-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Ethyl Ketone (2-Butanone)	000078-93-3	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Hydrazine	000060-34-4	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Iodide (Iodomethane)	000074-88-4	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone (Hexone)	000108-10-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isocyanate	000624-83-9	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isothiocyanate	000556-61-6	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Mercaptan	000074-93-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Methacrylate	000080-62-6	NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Methyl Phenkapton	003735-23-7	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Phosphonic Dichloride	000676-97-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Tert Butyl Ether	001634-04-4	NA	NA	3 g	3 g	0.5 g	2 g	0.2 g	0.04 g
Methyl Thiocyanate	000556-64-9	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Vinyl Ketone	000078-94-4	NA	NA	NA	NA	NA	NA	NA	NA
Methyl chloroform (1,1,1-Trichloroethane)	000071-55-6	0.2	0.2	100	40	40	100	1	0.2
Methyl-1-Butene, 2-	000563-46-2	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-1-Butene, 3-	000563-45-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-1-Pentene, 2-	000763-29-1	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-1-Pentene, 4-	000691-37-2	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-2-Butene, 2-	000513-35-9	NA	NA	NA	NA	NA	NA	NA	NA
Methyl-2-Pentene, 2-	000625-27-4	NA	NA	NA	NA	NA	NA	NA	NA
Methylcyclohexane	000108-87-2	NA	NA	NA	NA	NA	NA	NA	NA
Methylcyclopentane	000096-37-7	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride (Dichloromethane)	000075-09-2	zero	0.005	10	2	NA	NA	2	NA
Methylene Diphenyl Diisocyanate (MDI)	000101-68-8	NA	NA	NA	NA	NA	NA	NA	NA
Methylene bis(2-chloroaniline), 4,4'-	000101-14-4	NA	NA	NA	NA	NA	NA	NA	NA
Methylenedianiline, 4,4'-	000101-77-9	NA	NA	NA	NA	NA	NA	NA	NA
Methylheptane, 2-		NA	NA	NA	NA	NA	NA	NA	NA
Methylhexane, 3-	000589-34-4	NA	NA	NA	NA	NA	NA	NA	NA
Methylhydantoin, 5-Ethyl-1,3-diglycidyl-5-	000592-27-8	NA	NA	NA	NA	NA	NA	NA	NA
Methylmercuric Dicyanamide	000502-39-6	NA	NA	NA	NA	NA	NA	NA	NA
Methylnaphthalene, 2-	000091-57-6	NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Methylpentane, 2-	000107-83-5	NA	NA	NA	NA	NA	NA	NA	NA
Methylpentane, 3-	000096-14-0	NA	NA	NA	NA	NA	NA	NA	NA
Methyltrichlorosilane	000075-79-6	NA	NA	NA	NA	NA	NA	NA	NA
Methytlnaphthalene, 1-	001321-94-4	NA	NA	NA	NA	NA	NA	NA	NA
Mevinphos (Phosdrin)	007786-34-7	NA	NA	NA	NA	NA	NA	NA	NA
Mexacarbate	000315-18-4	NA	NA	NA	NA	NA	NA	NA	NA
Mineral fibers		NA	NA	NA	NA	NA	NA	NA	NA
Mitomycin C	000050-07-7	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum	007439-98-7	NA	NA	0.2 [g]	0.02 [g]	0.01 [g]	0.05 [g]	0.2 [g]	0.04 [g]
Molybdenum (Insoluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum (Soluble compounds)		NA	NA	0.2 [g]	0.02 [g]	0.01 [g]	0.05 [g]	0.2 [g]	0.04 [g]
Monocrotophos	006923-22-4	NA	NA	NA	NA	NA	NA	NA	NA
Monoethylamine (Ethylamine)	000075-04-7	NA	NA	NA	NA	NA	NA	NA	NA
Muscimol	002763-94-4	NA	NA	NA	NA	NA	NA	NA	NA
Mustard Gas	000505-60-2	NA	NA	NA	NA	NA	NA	NA	NA
Myrcene	000123-35-3	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	000091-20-3	NA	NA	0.5	0.5	0.4	1	0.1	0.02
Naphthaleneamine, 2-		NA	NA	NA	NA	NA	NA	NA	NA
Naphthylamine, 2-	000091-59-8	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	007440-02-0	0.1 [c]	0.1 [c]	1	1	0.5	1.7	0.6	0.1
Nickel (Metal)	007440-02-0	0.1	0.1	1	1	0.5	1.7	0.6	0.1
Nickel (Refinery dust)	007440-02-0	NA	NA	NA	NA	NA	NA	NA	NA
Nickel (Soluble compounds)		0.1	0.1	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Nickel (Soluble salts)		NA	NA	NA	NA	NA	NA	NA	NA
Nickel Carbonyl	013463-39-3	NA	NA	NA	NA	NA	NA	NA	NA
Nicotine	000054-11-5	NA	NA	NA	NA	NA	NA	NA	NA
Nicotine Sulfate	000065-30-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitric Acid	007697-37-2	NA	NA	NA	NA	NA	NA	NA	NA
Nitric Oxide	010102-43-9	NA	NA	NA	NA	NA	NA	NA	NA
Nitrobenzene	000098-95-3	NA	NA	NA	NA	NA	NA	NA	NA
Nitrobiphenyl, 4- (or 4-Nitrodiphenyl)	000092-93-3	NA	NA	NA	NA	NA	NA	NA	NA
Nitrocellulose	009004-70-0	NA	NA	NA	NA	NA	NA	NA	NA
Nitrocyclohexane	001122-60-7	NA	NA	NA	NA	NA	NA	NA	NA
Nitrodiphenylamine, 2-	000199-75-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitrodiphenylamine, 4-	000836-30-6	NA	NA	NA	NA	NA	NA	NA	NA
Nitrogen Dioxide	010102-44-0	NA	NA	NA	NA	NA	NA	NA	NA
Nitroglycerine	000055-63-0	NA	NA	NA	NA	NA	NA	NA	NA
Nitroguanidine	000556-88-7	NA	NA	10	10	10	40	4	0.7
Nitromethane	000075-52-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitronaphthalene, 2-	000581-89-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitrophenol, 4-	000100-02-7	NA	NA	0.8	0.8	0.8	3	0.3	0.06
Nitrophenol, o-	000088-75-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitropropane, 2-	000079-46-9	NA	NA	NA	NA	NA	NA	NA	NA
Nitropyrene, 1-		NA	NA	NA	NA	NA	NA	NA	NA
Nitroso-N-methylurea, N-	000684-93-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitrosochethylamine, N-		NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Nitrosodimethylamine, N-	000062-75-9	NA	NA	NA	NA	NA	NA	NA	NA
Nitrosodiphenylamine, 4-	000156-10-5	NA	NA	NA	NA	NA	NA	NA	NA
Nitrosodiphenylamine, N-	000086-30-6	NA	NA	NA	NA	NA	NA	NA	NA
Nitrosomorpholine, N-	000059-89-2	NA	NA	NA	NA	NA	NA	NA	NA
Nonane, n-	000111-84-2	NA	NA	NA	NA	NA	NA	NA	NA
Norbormide	000991-42-4	NA	NA	NA	NA	NA	NA	NA	NA
Octane, n-	000111-65-9	NA	NA	NA	NA	NA	NA	NA	NA
Organorthodium Complex (PMN-92-147)		NA	NA	NA	NA	NA	NA	NA	NA
Ouabain	000630-60-4	NA	NA	NA	NA	NA	NA	NA	NA
Oxamyl	023135-22-0	0.2	0.2	0.2	0.2	0.2	0.9	0.9	0.2
Oxetane, 3,3-Bis(chloromethyl)-	000078-71-7	NA	NA	NA	NA	NA	NA	NA	NA
Oxydisulfoton	002497-07-6	NA	NA	NA	NA	NA	NA	NA	NA
Ozone	010028-15-6	NA	NA	NA	NA	NA	NA	NA	NA
Paraquat	004685-14-7	NA	NA	0.1	0.1	0.05	0.2	0.2	0.03
Paraquat Methosulfate	002074-50-2	NA	NA	NA	NA	NA	NA	NA	NA
Parathion	000056-38-2	NA	NA	NA	NA	NA	NA	NA	NA
Parathion, Methyl	000298-00-0	NA	NA	0.3	0.3	0.03	0.1	0.009	0.002
Paris Green	012002-03-8	NA	NA	NA	NA	NA	NA	NA	NA
Particulates (PM10)		NA	NA	NA	NA	NA	NA	NA	NA
Particulates (PM10, total dust)		NA	NA	NA	NA	NA	NA	NA	NA
Pentaborane	019624-22-7	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloronitrobenzene (Quintobenzene)	000082-68-8	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	000087-86-5	zero	0.001	1	0.3	0.3	1	1	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Pentadecylamine	002570-26-5	NA	NA	NA	NA	NA	NA	NA	NA
Pentaerythritol Tetranitrate (PETN)	000078-11-5	NA	NA	NA	NA	NA	NA	NA	NA
Pentene	025377-72-4	NA	NA	NA	NA	NA	NA	NA	NA
Pentene, 1-	000109-67-1	NA	NA	NA	NA	NA	NA	NA	NA
Pentene, cis-2-	000627-20-3	NA	NA	NA	NA	NA	NA	NA	NA
Pentene, trans-2-	000646-04-8	NA	NA	NA	NA	NA	NA	NA	NA
Peracetic Acid	000079-21-0	NA	NA	NA	NA	NA	NA	NA	NA
Perchloromethylmercaptan	000594-42-3	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	000085-01-8	NA	NA	NA	NA	NA	NA	NA	NA
Phenol	000108-95-2	NA	NA	6[g]	6[g]	6[g]	20[g]	20[g]	4[g]
Phenol, 2,2 Thiobis(4-chloro-6-methyl)-	004418-66-0	NA	NA	NA	NA	NA	NA	NA	NA
Phenol, 3-(1 Methylethyl)-, Methylcarbamate	000064-00-6	NA	NA	NA	NA	NA	NA	NA	NA
Phenoxarsine, 10, 10-Oxydi-	000058-36-6	NA	NA	NA	NA	NA	NA	NA	NA
Phenyl Dichloroarsine	000696-28-6	NA	NA	NA	NA	NA	NA	NA	NA
Phenyldiisodecyl Phosphite		NA	NA	NA	NA	NA	NA	NA	NA
Phenylenediamine, p	000106-50-3	NA	NA	NA	NA	NA	NA	NA	NA
Phenylhydrazine Hydrochloride	000059-88-1	NA	NA	NA	NA	NA	NA	NA	NA
Phenylmercury Acetate	000062-38-4	NA	NA	NA	NA	NA	NA	NA	NA
Phenylsilatrane	002097-19-0	NA	NA	NA	NA	NA	NA	NA	NA
Phenylthiourea	000103-85-5	NA	NA	NA	NA	NA	NA	NA	NA
Phorate	000298-02-2	NA	NA	NA	NA	NA	NA	NA	NA
Phosacetim	004104-14-7	NA	NA	NA	NA	NA	NA	NA	NA
Phosfolan	000947-02-4	NA	NA	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Phosgene	000075-44-5	NA	NA	NA	NA	NA	NA	NA	NA
Phosmet	000732-11-6	NA	NA	NA	NA	NA	NA	NA	NA
Phosphamidon	013171-21-6	NA	NA	NA	NA	NA	NA	NA	NA
Phosphine	007803-51-2	NA	NA	NA	NA	NA	NA	NA	NA
Phosphonothioic Acid, Methyl-, O-(4-nitrophenyl) O-phenyl ester	002665-30-7	NA	NA	NA	NA	NA	NA	NA	NA
Phosphonothioic Acid, Methyl-, O-ethyl O-(4-(methylthio)phenyl) ester	002703-13-1	NA	NA	NA	NA	NA	NA	NA	NA
Phosphonothioic Acid, Methyl-, S-(2-(Bis(1-methylethyl)amino)ethyl O-ethyl ester	050782-69-9	NA	NA	NA	NA	NA	NA	NA	NA
Phosphoric Acid, Dimethyl 4-(methylthio) phenyl ester	003254-63-5	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorothioic Acid, O,O-Dimethyl-S-(2-methylthio)ethyl ester	002587-90-8	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus	007723-14-0	NA	NA	NA	NA	NA	NA	0.0005	0.0001
Phosphorus (white, yellow)	007723-14-0	NA	NA	NA	NA	NA	NA	0.0005	0.0001
Phosphorus Oxychloride	010025-87-3	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus Pentachloride	010026-13-8	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus Pentoxide	001314-56-3	NA	NA	NA	NA	NA	NA	NA	NA
Phosphorus Trichloride	007719-12-2	NA	NA	NA	NA	NA	NA	NA	NA
Phthalic Anhydride	000085-44-9	NA	NA	NA	NA	NA	NA	NA	NA
Physostigmine	000057-47-6	NA	NA	NA	NA	NA	NA	NA	NA
Physotigmine, Salicylate (1:1)	000057-64-7	NA	NA	NA	NA	NA	NA	NA	NA
Picric acid	000088-89-1	NA	NA	NA	NA	NA	NA	NA	NA
Picrotoxin	000124-87-8	NA	NA	NA	NA	NA	NA	NA	NA
Pinene, alpha-	000080-56-8	NA	NA	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Pinene, beta-	000127-91-3	NA	NA	NA	NA	NA	NA	NA	NA
Piperidine	000110-89-4	NA	NA	NA	NA	NA	NA	NA	NA
Pirimifos, Ethyl	023505-41-1	NA	NA	NA	NA	NA	NA	NA	NA
Polychlorinated Biphenyls (Aroclors)	001336-36-3	zero	0.0005	NA	NA	NA	NA	NA	NA
Polycylic Organic Matter		NA	NA	NA	NA	NA	NA	NA	NA
Polystyrene	009003-53-6	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	007440-09-7	NA	NA	NA	NA	NA	NA	NA	NA
Potassium Arsenide	010124-50-2	NA	NA	NA	NA	NA	NA	NA	NA
Potassium Cyanide	000151-50-8	NA	NA	NA	NA	NA	NA	NA	NA
Potassium Hydroxide	001310-58-3	NA	NA	NA	NA	NA	NA	NA	NA
Potassium Nitrate	007757-79-1	NA	NA	NA	NA	NA	NA	NA	NA
Potassium Silver Cyanide	000506-61-6	NA	NA	NA	NA	NA	NA	NA	NA
Promecarb	002631-37-0	NA	NA	NA	NA	NA	NA	NA	NA
Propane	000074-98-6	NA	NA	NA	NA	NA	NA	NA	NA
Propane Sultone, 1,3-	001120-71-4	NA	NA	NA	NA	NA	NA	NA	NA
Propargyl Bromide	000106-96-7	NA	NA	NA	NA	NA	NA	NA	NA
Propiolactone, Beta-	000057-57-8	NA	NA	NA	NA	NA	NA	NA	NA
Propionaldehyde	000123-38-6	NA	NA	NA	NA	NA	NA	NA	NA
Propionitrile	000107-12-0	NA	NA	NA	NA	NA	NA	NA	NA
Propionitrile, 3-Chloro-	000542-76-7	NA	NA	NA	NA	NA	NA	NA	NA
Propiophenone, 4-Amino-	000070-69-9	NA	NA	NA	NA	NA	NA	NA	NA
Propoxur (Baygon)	000114-26-1	NA	NA	0.04	0.04	0.04	0.1	0.1	0.003
Propyl Adipate, di-N-	000106-19-4	NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Propyl Chloroformate	000109-61-5	NA	NA	NA	NA	NA	NA	NA	NA
Propylbenzene, 1-	000103-65-1	NA	NA	NA	NA	NA	NA	NA	NA
Propylene Dichloride (1,2-Dichloropropane)	000078-87-5	zero	0.005	NA	0.09	NA	NA	NA	NA
Propylene Oxide	000075-56-9	NA	NA	NA	NA	NA	NA	NA	NA
Propyleneimine	000075-55-8	NA	NA	NA	NA	NA	NA	NA	NA
Prothoate	002275-18-5	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	000129-00-0	NA	NA	NA	NA	NA	NA	NA	NA
Pyridine, 2-Methyl-5-Vinyl-	000140-76-1	NA	NA	NA	NA	NA	NA	NA	NA
Pyridine, 4-Amino-	000504-24-5	NA	NA	NA	NA	NA	NA	NA	NA
Pyridine, 4-Nitro-, 1-Oxide	001124-33-0	NA	NA	NA	NA	NA	NA	NA	NA
Pyriminil	053558-25-1	NA	NA	NA	NA	NA	NA	NA	NA
Quinoline	000091-22-5	NA	NA	NA	NA	NA	NA	NA	NA
Quinone	000106-51-4	NA	NA	NA	NA	NA	NA	NA	NA
RDX (Cyclo-1,3,5-trimethylene-2,4,6-trinitramine)	000121-82-4	NA	NA	0.1	0.1	0.1	0.4	0.1	0.002
Radionuclides (Includes radon, See entries for specific compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Resorcinol	000108-46-3	NA	NA	NA	NA	NA	NA	NA	NA
Salane, (4-Aminobutyl)diethoxymethyl-	003037-72-7	NA	NA	NA	NA	NA	NA	NA	NA
Salcomine	014167-18-1	NA	NA	NA	NA	NA	NA	NA	NA
Salicylic Acid	000069-72-7	NA	NA	NA	NA	NA	NA	NA	NA
Sarin	000107-44-8	NA	NA	NA	NA	NA	NA	NA	NA
Selenious Acid	007783-00-8	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	007782-49-2	0.05	0.05	NA	NA	NA	NA	NA	NA
Selenium Compounds (as Se)		0.05	0.05	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child			70-kg Adult		
				One Day (mg/L)	Ten Day (mg/L)	Long Term (mg/L)	Long Term (mg/L)	DWEL (mg/L)	Lifetime (mg/L)
Selenium Oxychloride	007791-23-3	NA	NA	NA	NA	NA	NA	NA	NA
Semicarbazide Hydrochloride	000563-41-7	NA	NA	NA	NA	NA	NA	NA	NA
Silane, Trichloro(chloromethyl)-	001558-25-4	NA	NA	NA	NA	NA	NA	NA	NA
Silane, Trichloro(dichloropheny)-	027137-85-5	NA	NA	NA	NA	NA	NA	NA	NA
Silicon	007440-21-3	NA	NA	NA	NA	NA	NA	NA	NA
Silicon (Total dust)	007440-21-3	NA	NA	NA	NA	NA	NA	NA	NA
Silver (Metal dust and fume)	007440-22-4	NA	NA	0.2	0.2	0.2	0.2	0.2	0.1
Silver (Metal dust and soluble compounds)		NA	NA	0.2	0.2	0.2	0.2	0.2	0.1
Silver (Metal dust, soluble compounds, and fumes)		NA	NA	0.2	0.2	0.2	0.2	0.2	0.1
Silver (Soluble compounds)		NA	NA	0.2	0.2	0.2	0.2	0.2	0.1
Silver (metal)	007440-22-4	NA	NA	0.2	0.2	0.2	0.2	0.2	0.1
Sodium Arsenate	007631-89-2	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Arsenite	007784-46-5	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Azide	026628-22-8	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Cacodylate	000124-65-2	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Cyanide	000143-33-9	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Fluoroacetate	000062-74-8	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Nitrate	007631-99-4	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Selenate	013410-01-0	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Selenite	010102-18-8	NA	NA	NA	NA	NA	NA	NA	NA
Sodium Tellurite	010102-20-2	NA	NA	NA	NA	NA	NA	NA	NA
Stannane, Acetoxytriphenyl-	000900-95-8	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	007440-24-6	NA	NA	25	25	25	90	90	17

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

				10-kg Child			70-kg Adult		
Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	One Day (mg/L)	Ten Day (mg/L)	Long Term (mg/L)	Long Term (mg/L)	DWEL (mg/L)	Lifetime (mg/L)
Strychnine	000057-24-9	NA	NA	NA	NA	NA	NA	NA	NA
Strychnine Sulfate	000060-41-3	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	000100-42-5	0.1	0.1	20	2	2	7	7	0.1
Styrene Oxide	000096-09-3	NA	NA	NA	NA	NA	NA	NA	NA
Sulfotep (Tetraethyldithiopyrophosphate or TEDP)	003689-24-5	NA	NA	NA	NA	NA	NA	NA	NA
Sulfoxide, 3-Chloropropyl octyl	003569-57-1	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur	007704-34-9	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur Dioxide	007446-09-5	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur Dioxide, Anhydrous		NA	NA	NA	NA	NA	NA	NA	NA
Sulfur Tetrafluoride	007783-60-0	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur Trioxide	007446-11-9	NA	NA	NA	NA	NA	NA	NA	NA
Sulfuric Acid	007664-93-9	NA	NA	NA	NA	NA	NA	NA	NA
TEPP	000107-49-3	NA	NA	NA	NA	NA	NA	NA	NA
Tabun	000077-81-6	NA	NA	NA	NA	NA	NA	NA	NA
Tellurium	013494-80-9	NA	NA	NA	NA	NA	NA	NA	NA
Tellurium Hexafluoride	007783-80-4	NA	NA	NA	NA	NA	NA	NA	NA
Terbufos	013071-79-9	NA	NA	0.005	0.005	0.001	0.005	0.005	0.0009
Terpinene, alpha-	000099-86-5	NA	NA	NA	NA	NA	NA	NA	NA
Terpinene, delta-		NA	NA	NA	NA	NA	NA	NA	NA
Terpinolene	000586-62-9	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	001746-01-6	zero	3.00E-08	1.00E-06	1.00E-07	1.00E-08	4.00E-08	4.00E-08	NA
Tetrachloroethane, 1,1,2,2-	000079-34-5	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethylene (Perchloroethylene)	000127-18-4	zero	0.005	2	2	1	5	0.5	NA

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Tetranitromethane	000509-14-8	NA	NA	NA	NA	NA	NA	NA	NA
Tetryl (Trinitro-2,4-6-phenylmethylnitramine)	000479-45-8	NA	NA	NA	NA	NA	NA	NA	NA
Thallium Sulfate	010031-59-1	NA	NA	NA	NA	NA	NA	NA	NA
Thallous Carbonate	006533-73-9	NA	NA	NA	NA	NA	NA	NA	NA
Thallous Chloride	007791-12-0	NA	NA	NA	NA	NA	NA	NA	NA
Thallous Malonate	002757-18-8	NA	NA	NA	NA	NA	NA	NA	NA
Thallous Sulfate	007446-18-6	NA	NA	NA	NA	NA	NA	NA	NA
Thiocarbazide	002231-57-4	NA	NA	NA	NA	NA	NA	NA	NA
Thiofanox	039196-18-4	NA	NA	NA	NA	NA	NA	NA	NA
Thionazin	000297-97-2	NA	NA	NA	NA	NA	NA	NA	NA
Thiophenol	000108-98-5	NA	NA	NA	NA	NA	NA	NA	NA
Thiosemicarbazide	000079-19-6	NA	NA	NA	NA	NA	NA	NA	NA
Thiourea, (2-Chlorophenyl)-	005344-82-1	NA	NA	NA	NA	NA	NA	NA	NA
Thiourea, (2-Methylphenyl)-	000614-78-8	NA	NA	NA	NA	NA	NA	NA	NA
Tin (Metal)	007440-31-5	NA	NA	NA	NA	NA	NA	NA	NA
Tin (Organic compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Tin (Oxide and inorganic compounds except SnH4)		NA	NA	NA	NA	NA	NA	NA	NA
Tin (and compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Tin (inorganic compounds except oxides)	007440-31-5	NA	NA	NA	NA	NA	NA	NA	NA
Tin, Tetraethyl	000597-64-8	NA	NA	NA	NA	NA	NA	NA	NA
Titanium	007440-32-6	NA	NA	NA	NA	NA	NA	NA	NA
Titanium Tetrachloride	007550-45-0	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	000108-88-3	1	1	20	2	2	7	7	1

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

				10-kg Child			70-kg Adult		
Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	One Day (mg/L)	Ten Day (mg/L)	Long Term (mg/L)	Long Term (mg/L)	DWEL (mg/L)	Lifetime (mg/L)
Toluene 2,6-Disocyanate	000091-08-7	NA	NA	NA	NA	NA	NA	NA	NA
Toluene Diamine, 2,4-	000095-80-7	NA	NA	NA	NA	NA	NA	NA	NA
Toluene Diisocyanate	026471-62-5	NA	NA	NA	NA	NA	NA	NA	NA
Toluene, 2,4-Disocyanate	000584-84-9	NA	NA	NA	NA	NA	NA	NA	NA
Toluidine, o-	000095-53-4	NA	NA	NA	NA	NA	NA	NA	NA
Toxaphene (Chlorinated camphene)	008001-35-2	zero	0.003	NA	NA	NA	NA	NA	NA
Triacetin	000102-76-1	NA	NA	NA	NA	NA	NA	NA	NA
Triamiphos	001031-47-6	NA	NA	NA	NA	NA	NA	NA	NA
Triazofos	024017-47-8	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroacetyl Chloride	000076-02-8	NA	NA	NA	NA	NA	NA	NA	NA
Trichlorobenzene, 1,2,4-	000120-82-1	0.07	0.07	0.1	0.1	0.1	0.5	0.4	0.07
Trichloroethane, 1,1,2-	000079-00-5	0.003	0.005	0.6	0.4	0.4	1	0.1	0.003
Trichloroethylene	000079-01-6	zero	0.005	NA	NA	NA	NA	0.3	NA
Trichloroethylsilane	000115-21-9	NA	NA	NA	NA	NA	NA	NA	NA
Trichloronate	000327-98-0	NA	NA	NA	NA	NA	NA	NA	NA
Trichlorophenol, 2,4,5-	000095-95-4	NA	NA	0.2	0.2	0.07	0.3	0.3	0.05
Trichlorophenol, 2,4,6-	000088-06-2	NA	NA	NA	NA	NA	NA	NA	NA
Trichlorophenylsilane	000098-13-5	NA	NA	NA	NA	NA	NA	NA	NA
Triethoxysilane	000998-30-1	NA	NA	NA	NA	NA	NA	NA	NA
Triethylamine	000121-44-8	NA	NA	NA	NA	NA	NA	NA	NA
Trifluralin	001582-09-8	NA	NA	0.08	0.08	0.08	0.3	0.3	0.005
Trimethyl-3-phenylindane, 1,1,3-	003910-35-8	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylbenzene, 1,2,4-	000095-63-6	NA	NA	NA	NA	NA	NA	NA	NA

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Trimethylbenzene, 1,3,5-	000108-67-8	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylchlorosilane	000075-77-4	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylolpropane Phosphite	000824-11-3	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylpentane, 2,2,3-	054665-47-3	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylpentane, 2,2,4-	000540-84-1	NA	NA	NA	NA	NA	NA	NA	NA
Trimethylpentane, 2,3,4-	000565-75-3	NA	NA	NA	NA	NA	NA	NA	NA
Trimethyltin Chloride	001066-45-1	NA	NA	NA	NA	NA	NA	NA	NA
Trinitroanisole	028653-16-9	NA	NA	NA	NA	NA	NA	NA	NA
Trinitrobenzene, 1,3,5-	000099-35-4	NA	NA	NA	NA	NA	NA	NA	NA
Trinitroglycerol	000055-63-0	NA	NA	0.005	0.005	0.005	0.005	NA	0.005
Trinitrotoluene, 2,4,6-	000118-96-7	NA	NA	0.02	0.02	0.02	0.02	0.02	0.002
Triphenyltin Chloride	000639-58-7	NA	NA	NA	NA	NA	NA	NA	NA
Tris(2-Chloroethyl) Amine	000555-77-1	NA	NA	NA	NA	NA	NA	NA	NA
Uranium	007440-61-1	NA	NA	NA	NA	NA	NA	NA	NA
Uranium (Insoluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Uranium (Natural)	007440-61-1	zero p	0.02 p	NA	NA	NA	NA	NA	NA
Uranium (Soluble and insoluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Uranium (Soluble compounds)		NA	NA	NA	NA	NA	NA	NA	NA
Uranium Soluble Salts		NA	NA	NA	NA	NA	NA	NA	NA
Valinomycin	002001-95-8	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	007440-62-2	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium Pentoxide (as V2O5)	001314-62-1	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Acetate	000108-05-4	NA	NA	NA	NA	NA	NA	NA	NA

DRINKING WATER STANDARDS AND HEALTH ADVISORIES

Chemical	CAS Number	MCLG (mg/L)	MCL (mg/L)	10-kg Child One Day (mg/L)	10-kg Child Ten Day (mg/L)	10-kg Child Long Term (mg/L)	70-kg Adult Long Term (mg/L)	70-kg Adult DWEL (mg/L)	70-kg Adult Lifetime (mg/L)
Vinyl Bromide	000593-60-2	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	000075-01-4	zero	0.002	3	3	0.01	0.05	NA	NA
Vinylidene Chloride (1,1-Dichloroethylene)	000075-35-4	0.007	0.007	2	1	1	4	0.4	0.007
Warfarin	000081-81-2	NA	NA	NA	NA	NA	NA	NA	NA
Warfarin, Sodium	000129-06-6	NA	NA	NA	NA	NA	NA	NA	NA
Xylene (all isomers)	001330-20-7	10 f	10 f	40 f	40 f	40 f	100 f	60 f	10 f
Xylene Dichloride	028347-13-9	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, m-	000108-38-3	10 f	10 f	40 f	40 f	40 f	100 f	60 f	10 f
Xylene, o-	000095-47-6	10 f	10 f	40 f	40 f	40 f	100 f	60 f	10 f
Xylene, p-	000106-42-3	10 f	10 f	40 f	40 f	40 f	100 f	60 f	10 f
Xylenes (isomers and mixture)	001330-20-7	10 f	10 f	40 f	40 f	40 f	100 f	60 f	10 f
Xylenes (isomers and mixture) -m	000108-38-3	10 f	10 f	40 f	40 f	40 f	100 f	60 f	10 f
Xylenes (isomers and mixture) -o	000095-47-6	10 f	10 f	40 f	40 f	40 f	100 f	60 f	10 f
Xylenes (isomers and mixture) -p	000106-42-3	10 f	10 f	40 f	40 f	40 f	100 f	60 f	10 f
Zinc (metallic)	007440-66-6	NA	NA	6	6	3	10	10	2
Zinc Oxide (dust)	001314-13-2	NA	NA	NA	NA	NA	NA	NA	NA
Zinc Oxide (fume)	001314-13-2	NA	NA	NA	NA	NA	NA	NA	NA
Zinc Phosphide	001314-84-7	NA	NA	NA	NA	NA	NA	NA	NA
Zinc, Dichloro(4,4-dimethyl-5(((methylamino) carbonyl)oxy)imino)pentanenitrile)-(T-4)	058270-08-9	NA	NA	NA	NA	NA	NA	NA	NA
Zirconium (and compounds)		NA	NA	NA	NA	NA	NA	NA	NA

AL = Action Level; NA = Not Available

[a] Source: National Primary Drinking Water Regulations, 52 FR 25690, 7/8/87; 56 FR 3526, 1/30/91; 56 FR 26460, 67/791; 56 FR 30266, 7/1/91; 56 FR 33050, 7/18/91; 57 FR 31776, 7/17/92

[b] Source: U.S. Environmental Protection Agency, Office of Water Health Advisories as of May, 1993

[c] Effective 1/17/94

[d] Fibers/L > 10 μm Length

[e] Fibers/L x 10^6

[f] Value is for total xylenes

[g] Draft value for Health Advisory not final

OCCUPATIONAL STANDARDS AND CRITERIA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m³)	ACGIH TWA* (mg/m³)	NIOSH IDLH (mg/m³)	NIOSH TWA** (mg/m³)	NIOSH STEL/C (mg/m³)	OSHA TWA* (mg/m³)	OSHA STEL/C (mg/m³)
ANTU	000086-88-4	NA	0.3	100	0.3	NA	0.3	NA
Acetaldehyde	000075-07-0	45 (C) A3	NA	2,000 ppm Ca	NA Ca LF	NA	360	NA
Acetamide	000060-35-5	NA	NA	NA	NA	NA	NA	NA
Acetone Cyanohydrin	000075-86-5	5 (C)[s]	NA	NA	NA	4 (C)[e]	NA	NA
Acetone Thiosemicarbazide	001752-30-3	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	000075-05-8	101	67	500 ppm	34	NA	70	NA
Acetophenone	000098-86-2	NA	49	NA	NA	NA	NA	NA
Acetylaminofluorene, 2-	000053-96-3	NA	NA	Ca	Ca LF	NA	Ca[q]	NA
Acetylene	000074-86-2	NA[t]	NA[t]	NA	NA	2662 (C)	NA	NA
Acrolein	000107-02-8	0.69	0.23	2 ppm	0.25	0.3 ppm	0.25	NA
Acrylamide	000079-06-1	NA	0.03 A2[s]	60 Ca	0.3 Ca LF[s]	NA	0.3[s]	NA
Acrylic Acid	000079-10-7	NA	5.9[s]	NA	6[s]	NA	NA	NA
Acrylonitrile	000107-13-1	NA	4.3 A2[s]	85 ppm Ca	1 ppm Ca LF[s]	10 ppm (C)[e,s]	2 ppm Ca[q]	10 ppm (C)[e,q]
Acrylyl Chloride	000814-68-6	NA	NA	NA	NA	NA	NA	NA
Adiponitrile	000111-69-3	NA	8.8[s]	NA	18	NA	NA	NA
Aldicarb	000116-06-3	NA	NA	NA	NA	NA	NA	NA
Aldrin	000309-00-2	NA	0.25[s]	25 Ca	0.25 Ca LF[s]	NA	0.25[s]	NA
Allyl Alcohol	000107-18-6	9.5[s]	4.8[s]	20 ppm	5[s]	10[s]	5[s]	NA
Allyl Chloride	000107-05-1	6	3	250 ppm	3	6	3	NA
Allylamine	000107-11-9	NA	NA	NA	NA	NA	NA	NA
Aluminum	007429-90-5	NA	10	NA	10[m]	NA	15[m]	NA
Aluminum (alkyls)		NA	2	NA	2	NA	NA	NA
Aluminum (metal dust, respirable fraction)	007429-90-5	NA	10	NA	5	NA	5	NA
Aluminum (pyro powders)		NA	5	NA	5	NA	NA	NA
Aluminum (soluble salts)		NA	2	NA	2	NA	NA	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA[a] (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA[aa] (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA[a] (mg/m^3)	OSHA STEL/C (mg/m^3)
Aluminum (welding fume)	007429-90-5	NA	5	NA	5	NA	NA	NA
Aluminum Phosphide	020859-73-8	NA	NA	NA	NA	NA	NA	NA
Aminobiphenyl, 4-	000092-67-1	NA	A1 [s]	Ca	Ca LF	NA	NA [q]	NA
Aminopterin	000054-62-6	NA	NA	NA	NA	NA	NA	NA
Amiton	000078-53-5	NA	NA	NA	NA	NA	NA	NA
Amiton Oxalate	003734-97-2	NA	NA	NA	NA	NA	NA	NA
Ammonia	007664-41-7	24	17	300 ppm	18	27	35	NA
Ammonium Nitrate	006484-52-2	NA	NA	NA	NA	NA	NA	NA
Ammonium Picrate	000131-74-8	NA	NA	NA	NA	NA	NA	NA
Amosite	012172-73-5	0.5fbr/cc [A1]	NA	Ca	Ca LF	NA	0.2fbr/cc Ca [q]	NA
Amphetamine	000300-62-9	NA	NA	NA	NA	NA	NA	NA
Aniline	000062-53-3	NA	7.6 [s]	100 ppm Ca	Ca LF [s]	NA	19 [s]	NA
Aniline, 2,4,6-Trimethyl-	000088-05-1	NA	NA	NA	NA	NA	NA	NA
Anisidine, o-	000090-04-0	NA	0.5 [i,s]	50 Ca [i]	0.5 Ca [i,s]	NA	0.5 [i,s]	NA
Anthracene	000120-12-7	NA	NA	80 Ca	0.1 Ca LF [v]	NA	NA	NA
Antimony	007440-36-0	NA	0.5	50	0.5	NA	0.5	NA
Antimony Compounds (as Sb)		NA	0.5	50	0.5	NA	0.5	NA
Antimony Pentafluoride	007783-70-2	NA	NA	NA	NA	NA	0.5	NA
Antimycin A	001397-94-0	NA	NA	NA	NA	NA	NA	NA
Arsenic	007440-38-2	NA	0.01 A1	5 Ca	Ca LF [e]	0.002 (C) [e]	0.01, Ca [q]	NA
Arsenic (Inorganic compounds)		NA	0.01 A1	5 Ca	Ca LF	0.002 (C) [e]	0.01 Ca [q]	NA
Arsenic (Organic compounds)		NA	NA	NA	NA	NA	0.5 Ca [q]	NA
Arsenic Pentoxide	001303-28-2	NA	NA	NA	NA	NA	NA	NA
Arsenous Oxide	001327-53-3	NA	NA	NA	NA	NA	NA	NA
Arsenous Trichloride	007784-34-1	NA	NA	NA	NA	NA	NA	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Arsine	007784-42-1	NA	0.16	3 ppm Ca	Ca LF	0.002 (C) Ca [e]	0.2	NA
Asbestos	001332-21-4	NA	2 fbr/cc A1	Ca	Ca LF	NA	0.2 fbr/cc Ca [q]	NA
Azinphos-Ethyl	002642-71-9	NA	NA	NA	NA	NA	NA	NA
Azinphos-Methyl	000086-50-0	NA	0.2 [s]	10	0.2 [s]	NA	0.2 [s]	NA
Barium	007440-39-3	NA	0.5	NA	NA	NA	0.5	NA
Barium (Soluble compounds)		NA	0.5	50	0.5	NA	0.5	NA
Barium Nitrate	010022-31-8	NA	NA	50	0.5	NA	NA	NA
Benzal Chloride	000098-87-3	NA	NA	NA	NA	NA	NA	NA
Benzenamine, 3-(Trifluoromethyl)	000098-16-8	NA	NA	NA	NA	NA	NA	NA
Benzene	000071-43-2	NA	32, A2	500 ppm Ca	0.1 ppm Ca LF	1 ppm ST	1 ppm Ca [q,aa]	5 ppm ST [q,e,bb,cc]
Benzene, 1-(Chloromethyl)-4-nitro-	000100-14-1	NA	NA	NA	NA	NA	NA	NA
Benzenearsonic Acid	000098-05-5	NA	NA	NA	NA	NA	NA	NA
Benzidine	000092-87-5	NA	A1 [s]	Ca	Ca LF	NA	Ca [q]	NA
Benzimidazole, 4,5-Dichloro-2-(trifluoromethyl)	003615-21-2	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	000056-55-3	NA	A2	80 Ca	0.1 Ca LF	NA	0.2	NA
Benzo(a)pyrene (also see Coal Tar Pitch Volatiles)	000050-32-8	NA	A2	80 Ca	0.1 Ca LF [v]	NA	0.2	NA
Benzo(b)fluoranthene	000205-99-2	NA	A2	NA	NA	NA	NA	NA
Benzo(c)acridine		NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	000207-08-9	NA	NA	NA	NA	NA	NA	NA
Benzotrichloride	000098-07-7	NA	NA	NA	NA	NA	NA	NA
Benzyl Alcohol	000100-51-6	NA	NA	NA	NA	NA	NA	NA
Benzyl Chloride	000100-44-7	NA	5.2	10 ppm	NA	5 (C) [e]	5	NA
Benzyl Cyanide	000140-29-4	NA	NA	NA	NA	NA	NA	NA
Beryllium	007440-41-7	NA	0.002 A2	4 Ca	0.0005 Ca LF	NA	0.002 [aa]	0.005 (C) [bb,cc]
Beryllium Compounds (as Be)		NA	0.002 A2	4 Ca	0.0005 Ca LF	NA	0.002 [aa]	0.005 (C) [bb,cc]

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Bicyclo [2.2.1] Heptane-2-carbonitrile, 5-chlor-6-((((methylamino)carbonyl) oxy)imino)-(1	015271-41-7	NA	NA	NA	NA	NA	NA	NA
Biphenyl (diphenyl)	000092-52-4	NA	1.3	100	1	NA	1	NA
Bitoscanate	004044-65-9	NA	NA	NA	NA	NA	NA	NA
Boric Acid	010043-35-3	NA	NA	NA	NA	NA	NA	NA
Boron	007440-42-8	NA	NA	NA	NA	NA	NA	NA
Boron Trichloride	010294-34-5	NA	NA	NA	NA	NA	NA	NA
Boron Trifluoride	007637-07-2	2.8 (C)	NA	25 ppm	NA	3 (C)	3 (C)	NA
Boron Trifluoride Compound with Methyl Ether (1:1)	000353-42-4	NA	NA	NA	NA	NA	NA	NA
Bromadiolone	028772-56-7	NA	NA	NA	NA	NA	NA	NA
Bromine	007726-95-6	1.3	0.66	3 ppm	0.7	2 ST	0.7	NA
Bromoform	000075-25-2	NA	5.2 [s]	850 ppm	5 [s]	NA	5 [s]	NA
Butadiene, 1,3-	000106-99-0	NA	4.4 A2	2000 ppm [w]	Ca LF	NA	2200	NA
Butane, i-		NA	NA	NA	NA	NA	NA	NA
Butane, n-	000106-97-8	NA	1900	NA	1900	NA	NA	NA
Butene, 1-	000106-98-9	NA	NA	NA	NA	NA	NA	NA
Butene, cis-2-	000590-18-1	NA	NA	NA	NA	NA	NA	NA
Butene, i-		NA	NA	NA	NA	NA	NA	NA
Butene, trans-2-	000624-64-6	NA	NA	NA	NA	NA	NA	NA
Butyl benzyl phthalate	000085-68-7	NA	NA	NA	NA	NA	NA	NA
Butylbenzene, sec-	000135-98-8	NA	NA	NA	NA	NA	NA	NA
Butylphenol, 2,2-Methylene bis(4-methyl) 6-t-butylphen-		NA	NA	NA	NA	NA	NA	NA
Cadmium	007440-43-9	NA	0.01 A2 [m]	9 Ca	Ca LF	NA	0.005 Ca [q,aa]	NA [bb]
Cadmium (dust)	007440-43-9	NA	.002 A2 [g]	9 Ca	Ca LF [m]	NA	0.005 [q,aa]	0.6 (C) [bb]

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA[a] (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA[a][a] (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA[a] (mg/m^3)	OSHA STEL/C (mg/m^3)
Cadmium (dusts and salts)		NA	NA	NA	NA	NA	0.005[q,aa]	NA[bb]
Cadmium (fume)	007440-43-9	NA	NA	9 Ca	Ca LF	NA	0.005[q,aa]	0.3 (C)[bb]
Cadmium Compounds (as Cd)		NA	0.01 A2[m]	9 Ca[m]	Ca LF[m]	NA	0.005[q,aa]	NA[bb]
Cadmium Oxide	001306-19-0	NA	NA	NA	Ca LF	NA	0.005 Ca[q,aa]	NA[bb]
Cadmium Stearate	002223-93-0	NA	NA	NA	Ca LF	NA	0.005 Ca[q,aa]	NA[bb]
Calcium	007440-70-2	NA	NA	NA	NA	NA	NA	NA
Calcium Arsenate	007778-44-1	NA	NA	5 Ca	Ca LF	0.002 (C)[e]	NA	NA
Calcium Cyanamide	000156-62-7	NA	0.5	NA	NA	NA	NA	NA
Calcium Stearate	001592-23-0	NA	NA	NA	NA	NA	NA	NA
Camphechlor	008001-35-2	NA	NA	NA	NA	NA	NA	NA
Cantharidin	000056-25-7	NA	NA	NA	NA	NA	NA	NA
Caprolactam (dust)	000105-60-2	3	1	NA	1[m]	3 ST	NA	NA
Captan	000133-06-2	NA	5	Ca	5 Ca LF	NA	NA	NA
Carbachol Chloride	000051-83-2	NA	NA	NA	NA	NA	NA	NA
Carbamic Acid, Methyl, O-(((2,4-dimethyl-1, 3-dithiolan-2-yl) methylene)amino)-	026419-73-8	NA	NA	NA	NA	NA	NA	NA
Carbaryl	000063-25-2	NA	5	100	5	NA	5	NA
Carbofuran	001563-66-2	NA	0.1	NA	0.1	NA	NA	NA
Carbon Disulfide	000075-15-0	NA	31[s]	500 ppm	3[s]	30 ST	20 ppm[aa]	30 ppm (C)[bb,cc]
Carbon Monoxide	000630-08-0	NA	29	1200 ppm	40	229 (C)	55	NA
Carbon Tetrachloride	000056-23-5	63 A3[s]	31 A3[s]	200 ppm Ca	Ca LF	12.6 ST[x]	10 ppm[aa]	25 ppm (C)[bb,cc]
Carbonyl Sulfide	000463-58-1	NA	NA	NA	NA	NA	NA	NA
Carbophenothion	000786-19-6	NA	NA	NA	NA	NA	NA	NA
Carene, delta-3-	020296-50-8	NA	NA	NA	NA	NA	NA	NA
Catechol	000120-80-9	NA	23[s]	NA	20[s]	NA	NA	NA
Chloracetic Acid	000079-11-8	NA	NA	NA	NA	NA	NA	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Chloramben	000133-90-4	NA	NA	NA	NA	NA	NA	NA
Chlordane	000057-74-9	NA	0.5 [s]	100 Ca	0.5 Ca LF [s]	NA	0.5 [s]	NA
Chlorfenvinfos	000470-90-6	NA	NA	NA	NA	NA	NA	NA
Chlorine	007782-50-5	2.9	1.5	10 ppm	NA	1.45 (C) [e]	NA	3 (C)
Chlormephos	024934-91-6	NA	NA	NA	NA	NA	NA	NA
Chlormequat Chloride	000999-81-5	NA	NA	NA	NA	NA	NA	NA
Chloroacetophenone, 2-	000532-27-4	NA	0.32	15	0.3	NA	0.3	NA
Chlorobenzene	000108-90-7	NA	46	1000 ppm	NA	NA	350	NA
Chlorobenzilate	000510-15-6	NA	NA	NA	NA	NA	NA	NA
Chloroethanol	000107-07-3	3.3 (C) [s]	NA	7 ppm	NA [s]	3 (C) [s]	16 [s]	NA
Chloroethyl Chloroformate	000627-11-2	NA	NA	NA	NA	NA	NA	NA
Chloroform	000067-66-3	NA	49 A2	500 ppm Ca	Ca LF	9.78 ST [x]	NA	240 (C)
Chloromethyl Ether	000542-88-1	NA	0.0047 A1	Ca	Ca LF	NA	Ca [q]	NA
Chloromethyl Methyl Ether	000107-30-2	NA	A2	Ca	Ca LF	NA	Ca [q]	NA
Chlorophacinone	003691-35-8	NA	NA	NA	NA	NA	NA	NA
Chloroprene	000126-99-8	NA	36 [s]	300 ppm	Ca LF	3.6 (C) [e]	90 [s]	NA
Chloropropane, 1,2-dibromo-3-	000096-12-8	NA	NA	Ca	Ca LF	NA	0.001 ppm Ca [q]	NA
Chlorothiophos	021923-23-9	NA	NA	NA	NA	NA	NA	NA
Chloroxuron	001982-47-4	NA	NA	NA	NA	NA	NA	NA
Chromic Chloride	010025-73-7	NA	NA	NA	NA	NA	NA	NA
Chromium	007440-47-3	NA	0.5 A4	250	0.5	NA	1	NA
Chromium Compounds (As Cr) (does not include Cr VI cmpds)		NA	0.5 A4	25 [Y]	0.5	NA	0.5	NA
Chrysene	000218-01-9	NA	A2	80 Ca	0.1 Ca LF [v]	NA	0.2	NA
Chrysotile	012001-29-5	2fbr/ccA1	NA	Ca	Ca LF	NA	0.2fbr/cc Ca [q]	NA
Coal Tar Pitch Volatiles (as benzene solubles)	065996-93-2	NA	0.2 A1	80 Ca	0.1 Ca LF [v]	NA	0.2	NA

Revision Date: 04/06/95

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Cobalt Carbonyl	010210-68-1	NA	0.1	NA	0.1	NA	NA	NA
Cobalt Compounds		NA	NA	NA	NA	NA	NA	NA
Cobalt, ((2,2-(1,2-Ethanedlylbis (nitrilo-methylidyne))Bis (6-fluorophenolato))(2-)-NNOO)	062207-76-5	NA	NA	NA	NA	NA	NA	NA
Coke Oven Emissions		NA	NA	Ca	0.5-0.7 Ca LF	NA	0.150 Ca [q]	NA
Colchicine	000064-86-8	NA	NA	NA	NA	NA	NA	NA
Copper	007440-50-8	NA	1.0 [m]	100 [m]	1.0 [m]	NA	NA	NA
Copper (dusts and mists)	007440-50-8	NA	1.0	100	1	NA	1	NA
Copper (fume)	007440-50-8	NA	0.2	100	0.1	NA	0.1	NA
Coumaphos	000056-72-4	NA	NA	NA	NA	NA	NA	NA
Coumatetralyl	005836-29-3	NA	NA	NA	NA	NA	NA	NA
Cresols/Cresylic Acid (isomers and mixture) (cresol)	001319-77-3	NA	22 [n,s]	250 ppm [n]	10 [n]	NA	22 [n,s]	NA
Cresols/Cresylic Acid (isomers and mixture) (m-cresol)	000108-39-4	NA	22 [n,s]	250 ppm [n]	10 [n]	NA	22 [n,s]	NA
Cresols/Cresylic Acid (isomers and mixture) (o-cresol)	000095-48-7	NA	22 [n,s]	250 ppm [n]	10 [n]	NA	22 [n,s]	NA
Cresols/Cresylic Acid (isomers and mixture) (p-cresol)	000106-44-5	NA	22 [n,s]	250 ppm [n]	10 [n]	NA	22 [n,s]	NA
Crimidine	000535-89-7	NA	NA	NA	NA	NA	NA	NA
Crocidolite	012001-28-4	0.2fbr/cc [A1]	NA	Ca	Ca LF	NA	0.2fbr/cc Ca [q]	NA
Crotonaldehyde	004170-30-3	NA	5.7	50 ppm	6	NA	6	NA
Crotonaldehyde, (E)-	000123-73-9	NA	NA	50 ppm	6	NA	6	NA
Cumene (Isopropylbenzene)	000098-82-8	NA	246 [s]	900 ppm [w]	245 [s]	NA	245 [s]	NA
Cyanide Compounds (as free cyanide)		5 (C) [s]	NA	50ppm	NA	5 ST [s]	5	NA
Cyanogen Bromide	000506-68-3	NA	NA	NA	NA	NA	NA	NA
Cyanogen Iodide	000506-78-5	NA	NA	NA	NA	NA	NA	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Cyanophos	002636-26-2	NA	NA	NA	NA	NA	NA	NA
Cyanuric Fluoride	000675-14-9	NA	NA	NA	NA	NA	NA	NA
Cycloheximide	000066-81-9	NA	NA	NA	NA	NA	NA	NA
Cyclohexylamine	000108-91-8	NA	41	NA	40	NA	NA	NA
Cyclopentane	000287-92-3	NA	1720	NA	1720	NA	NA	NA
Cyclopentene	000142-29-0	NA	NA	NA	NA	NA	NA	NA
DDE	003547-04-4	NA	NA	NA	NA	NA	NA	NA
DEHP (Bis(2-ethylhexyl)phthalate)	000117-81-7	10	5	5000 Ca	5 Ca LF	10 ST	5	NA
Decaborane (14)	017702-41-9	0.75 [s]	0.25 [s]	15	0.3 [s]	0.9 ST	0.3 [s]	NA
Demeton	008065-48-3	NA	0.11 [s]	10	0.1 [s]	NA	0.1 [s]	NA
Demeton-S-Methyl	000919-86-8	NA	NA	NA	NA	NA	NA	NA
Dialifor	010311-84-9	NA	NA	NA	NA	NA	NA	NA
Diazomethane	000334-88-3	NA	0.34	2 ppm	0.4	NA	0.4	NA
Dibenz(a,h)anthracene	000053-70-3	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	000132-64-9	NA	NA	NA	NA	NA	NA	NA
Diborane	019287-45-7	NA	0.11	15 ppm	0.1	NA	0.1	NA
Dibutylphthalate	000084-74-2	NA	5	4000	5	NA	5	NA
Dichlorobenzene, 1,4- (p)	000106-46-7	NA	60 A3	150 ppm Ca	Ca LF	NA	450	NA
Dichlorobenzidine, 3,3'-	000091-94-1	NA	A2 [s]	Ca	Ca LF	NA	Ca [q]	NA
Dichlorobutene, Trans-1,4-	000110-57-6	NA	NA	NA	NA	NA	NA	NA
Dichloroethyl Ether (Bis(2-chloroethyl)ether)	000111-44-4	58 [s]	29 [s]	100 ppm Ca	30 Ca LF [s]	60 ST	NA [s]	90 (C)
Dichloromethylphenylsilane	000149-74-6	NA	NA	NA	NA	NA	NA	NA
Dichlorophenoxyacetic Acid, 2,4- (2,4-D) salts and esters	000094-75-7	NA	10	100	10	NA	10	NA
Dichloropropene, 1,3-	000542-75-6	NA	4.5 [s]	Ca	5 Ca [s]	NA	NA	NA
Dichlorvos (DDVP)	000062-73-7	NA	0.90 [s]	100	1 [s]	NA	1 [s]	NA

Revision Date: 04/06/95

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH		NIOSH			OSHA	
		STEL/C (mg/m³)	TWA* (mg/m³)	IDLH (mg/m³)	TWA** (mg/m³)	STEL/C (mg/m³)	TWA* (mg/m³)	STEL/C (mg/m³)
Dicrotophos (Bidrin)	000141-66-2	NA	0.25 s	NA	0.25 s	NA	NA	NA
Diepoxide		NA	NA	NA	NA	NA	NA	NA
Diepoxybutane	001464-53-5	NA	NA	NA	NA	NA	NA	NA
Diethanolamine	000111-42-2	NA	2 s	NA	15	NA	NA	NA
Diethyl Chlorophospate	000814-49-3	NA	NA	NA	NA	NA	NA	NA
Diethyl Phthalate	000084-66-2	NA	5	NA	5	NA	NA	NA
Diethyl Sulfate	000064-67-5	NA	NA	NA	NA	NA	NA	NA
Diethylcarbamazine Citrate	001642-54-2	NA	NA	NA	NA	NA	NA	NA
Diethylenetriamine	000111-40-0	NA	4.2 s	NA	4 s	NA	NA	NA
Diethylhexylsebacate		NA	NA	NA	NA	NA	NA	NA
Digitoxin	000071-63-6	NA	NA	NA	NA	NA	NA	NA
Diglycidyl Ether	002238-07-5	NA	0.53	10 ppm Ca	0.5 Ca LF	NA	NA	2.8 (C)
Digoxin	020830-75-5	NA	NA	NA	NA	NA	NA	NA
Diisopropylmethylphosphonate	001445-75-6	NA	NA	NA	NA	NA	NA	NA
Dimefox	000115-26-4	NA	NA	NA	NA	NA	NA	NA
Dimethoate	000060-51-5	NA	NA	NA	NA	NA	NA	NA
Dimethoxybenzidine, 3,3'-	000119-90-4	NA	NA	NA	NA	NA	NA	NA
Dimethyl Aminoazobenzene	000060-11-7	NA	NA	Ca	Ca LF	NA	NA	NA
Dimethyl Carbamoyl Chloride	000079-44-7	NA	A2	NA	NA	NA	NA	NA
Dimethyl Formamide	000068-12-2	NA	30 s	500 ppm	30 s	NA	30 s	NA
Dimethyl Phosphorochloridothioate	002524-03-0	NA	NA	NA	NA	NA	NA	NA
Dimethyl Phthalate	000131-11-3	NA	5	2000	5	NA	5	NA
Dimethyl Sulfate	000077-78-1	NA	0.52 A2 s	7 ppm Ca	0.5 Ca LF s	NA	5 s	NA
Dimethyl-p-Phenylenediamine	000099-98-9	NA	NA	NA	NA	NA	NA	NA
Dimethylaniline (N,N-Dimethylaniline)	000121-69-7	50 s	25 s	100 ppm	25 s	50 ST s	25 s	NA

Revision Date: 04/06/95

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Dimethylbenzidine, 3,3'-	000119-93-7	NA	A2 [s]	Ca	Ca LF [s]	0.02 (C) [s,x]	NA	NA
Dimethylbutane, 2,2-	000075-83-2	NA	NA	NA	NA	NA	NA	NA
Dimethylbutane, 2,3-	000079-29-8	NA	NA	NA	NA	NA	NA	NA
Dimethyldichlorosilane	000075-78-5	NA	NA	NA	NA	NA	NA	NA
Dimethylhexane, 2,3-		NA	NA	NA	NA	NA	NA	NA
Dimethylhexane, 2,4-		NA	NA	NA	NA	NA	NA	NA
Dimethylhydrazine	000057-14-7	NA	1.2 A2 [s]	15 ppm Ca	Ca LF	0.15 (C) [r]	1 [s]	NA
Dimethylpentane, 2,4-	000108-08-7	NA	NA	NA	NA	NA	NA	NA
Dimethylphenethylamine, alpha, alpha-		NA	NA	NA	NA	NA	NA	NA
Dimetilan	000644-64-4	NA	NA	NA	NA	NA	NA	NA
Dinitro-o-cresol, 4,6- and salts	000534-52-1	NA	0.2 [s]	5	0.2 [s]	NA	0.2 [s]	NA
Dinitrobenzene, 1,3-	000099-65-0	NA	1.0 [s]	50	1.0 [s]	NA	1.0 [s]	NA
Dinitrobenzenes (all isomers)	025154-54-5	NA	1.0 [s]	50	1.0 [s]	NA	1.0 [s]	NA
Dinitrocresol	000534-52-1	NA	0.2 [s]	5	0.2 [s]	NA	0.2 [s]	NA
Dinitrophenol, 2,4-	000051-28-5	NA	NA	NA	NA	NA	NA	NA
Dinitropyrene, 1,6-	042397-64-8	NA	NA	NA	NA	NA	NA	NA
Dinitrotoluene	025321-14-6	NA	0.15 A2 [s,u]	50 Ca [u]	1.5 Ca LF [s,u]	NA	1.5 [s,u]	NA
Dinitrotoluene, 2,4-	000121-14-2	NA	0.15 A2 [s,u]	50 Ca [u]	1.5 Ca LF [s,u]	NA	1.5 [s,u]	NA
Dinitrotoluene, 2,6-	000606-20-2	NA	0.15 A2 [s,u]	50 Ca [u]	1.5 Ca LF [s,u]	NA	1.5 [s,u]	NA
Dinitrotoluene, Mixture		NA	NA	NA	NA	NA	NA	NA
Dinoseb	000088-85-7	NA	NA	NA	NA	NA	NA	NA
Dinoterb	001420-07-1	NA	NA	NA	NA	NA	NA	NA
Dioctyl Sebacate	000122-62-3	NA	NA	NA	NA	NA	NA	NA
Dioxane, 1,4- (1,4-Diethyleneoxide)	000123-91-1	NA	90 [s]	500 ppm Ca	Ca LF	3.6 (C) [p]	360 [s]	NA
Dioxathion	000078-34-2	NA	0.2 [s]	NA	0.2 [s]	NA	NA	NA

OCCUPATIONAL STANDARDS AND CRITERIA*

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Diphacinone	000082-66-6	NA	NA	NA	NA	NA	NA	NA
Diphenylamine	000122-39-4	NA	10	NA	10	NA	NA	NA
Diphenylhydrazine, 1,2-	000122-66-7	NA	NA	NA	NA	NA	NA	NA
Diphenyloxazole, 2,5-	000092-71-7	NA	NA	NA	NA	NA	NA	NA
Diphosphoramide, Octamethyl-	000152-16-9	NA	NA	NA	NA	NA	NA	NA
Disulfoton	000298-04-4	NA	0.1 [s]	NA	0.1 [s]	NA	NA	NA
Dithiazanine Iodide	000514-73-8	NA	NA	NA	NA	NA	NA	NA
Dithiobiuret	000541-53-7	NA	NA	NA	NA	NA	NA	NA
EPN	002104-64-5	NA	0.1 [s]	5	0.5 [s]	NA	0.5 [s]	NA
Emetine, Dihydrochloride	000316-42-7	NA	NA	NA	NA	NA	NA	NA
Endosulfan	000115-29-7	NA	0.1 [s]	NA	0.1 [s]	NA	0.1 [s]	NA
Endothion	002778-04-3	NA	NA	NA	NA	NA	NA	NA
Endrin	000072-20-8	NA	0.1 [s]	2	0.1 [s]	NA	0.1 [s]	NA
Epichlorohydrin	000106-89-8	NA	7.6 [s]	75 ppm Ca	Ca LF	NA	19 [s]	NA
Epoxybutane, 1,2-	000106-88-7	NA	NA	NA	NA	NA	NA	NA
Ergocalciferol	000050-14-6	NA	NA	NA	NA	NA	NA	NA
Ergotamine Tartrate	000379-79-3	NA	NA	NA	NA	NA	NA	NA
Ethane	000074-84-0	NA [t]	NA [t]	NA	NA	NA	NA	NA
Ethanesulfonyl Chloride, 2-Chloro	001622-32-8	NA	NA	NA	NA	NA	NA	NA
Ethanol, 1,2-Dichloro-, Acetate	010140-87-1	NA	NA	NA	NA	NA	NA	NA
Ethion	000563-12-2	NA	0.4 [s]	NA	0.4 [s]	NA	NA	NA
Ethoprophos	013194-48-4	NA	NA	NA	NA	NA	NA	NA
Ethybis(2-Chloroethyl)amine	000538-07-8	NA	NA	NA	NA	NA	NA	NA
Ethyl Acrylate	000140-88-5	61 A2	20 A2	300 ppm	Ca LF	NA	100 [s]	NA
Ethyl Benzene	000100-41-4	543	434	800 ppm	435	545 ST	435	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA[a] (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA[a,a] (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA[a] (mg/m^3)	OSHA STEL/C (mg/m^3)
Ethyl Carbamate (Urethane)	000051-79-6	NA	NA	NA	NA	NA	NA	NA
Ethyl Chloride (Chloroethane)	000075-00-3	NA	2640	3800 ppm[w]	Ca	NA	2600	NA
Ethylcyclohexane	001678-91-7	NA	NA	NA	NA	NA	NA	NA
Ethylene	000074-85-1	NA[t]	NA[t]	NA	NA	NA	NA	NA
Ethylene Dibromide (Dibromoethane)	000106-93-4	NA	A2[s]	100 ppm Ca	0.045 ppm Ca LF	0.13 ppm (C)[e]	20 ppm[aa]	30 ppm (C)[bb,cc]
Ethylene Dichloride (1,2-Dichloroethane)	000107-06-2	NA	40	50 ppm Ca	4 Ca LF	8 ST	50 ppm[aa]	100 ppm (C)[bb,cc]
Ethylene Fluorohydrin	000371-62-0	NA	NA	NA	NA	NA	NA	NA
Ethylene Glycol	000107-21-1	127 (C)	NA	NA	NA	NA	NA	NA
Ethylene Oxide	000075-21-8	NA	1.8 A2	800 ppm Ca	<0.18 Ca LF	9 (C)[f]	1 ppm Ca[q]	NA
Ethylene Thiourea	000096-45-7	NA	NA	Ca	Ca LF	NA	NA	NA
Ethylenediamine	000107-15-3	NA	25[s]	1000 ppm	25	NA	25	NA
Ethyleneimine	000151-56-4	NA	0.88[s]	100 ppm Ca	Ca LF	NA	Ca[q]	NA
Ethylhexane, 3-	000619-99-8	NA	NA	NA	NA	NA	NA	NA
Ethylidene Dichloride (1,1-Dichloroethane)	000075-34-3	NA	405	3000 ppm	400 Ca	NA	400	NA
Ethylthiocyanate	000542-90-5	NA	NA	NA	NA	NA	NA	NA
Ethyltoluene, 1-		NA	NA	NA	NA	NA	NA	NA
Ethyltoluene, 2-	000611-14-3	NA	NA	NA	NA	NA	NA	NA
Ethyltoluene, 3-	000620-14-4	NA	NA	NA	NA	NA	NA	NA
Fenamiphos	022224-92-6	NA	0.1[s]	NA	0.1[s]	NA	NA	NA
Fenitrothion	000122-14-5	NA	NA	NA	NA	NA	NA	NA
Fensulfothion	000115-90-2	NA	0.1	NA	0.1	NA	NA	NA
Fluenetil	004301-50-2	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	000206-44-0	NA	NA	NA	NA	NA	NA	NA
Fluorene	000086-73-7	NA	NA	NA	NA	NA	NA	NA
Fluorine	007782-41-4	3.1	1.6	25 ppm	0.2	NA	0.2	NA

Revision Date: 04/06/95

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m³)	ACGIH TWA* (mg/m³)	NIOSH IDLH (mg/m³)	NIOSH TWA** (mg/m³)	NIOSH STEL/C (mg/m³)	OSHA TWA* (mg/m³)	OSHA STEL/C (mg/m³)
Fluoroacetamide	000640-19-7	NA	NA	NA	NA	NA	NA	NA
Fluoroacetic Acid	000144-49-0	NA	NA	NA	NA	NA	NA	NA
Fluoroacetyl Chloride	000359-06-8	NA	NA	NA	NA	NA	NA	NA
Fluorouracil	000051-21-8	NA	NA	NA	NA	NA	NA	NA
Fonofos	000944-22-9	NA	0.1 [s]	NA	0.1 [s]	NA	NA	NA
Formaldehyde	000050-00-0	0.37(C)A2	NA	20 ppm Ca	0.016 ppm Ca LF	0.1 ppm (C) [e]	0.75 ppm Ca [q]	2 ppm ST [e,q]
Formaldehyde Cyanohydrin	000107-16-4	NA	NA	NA	NA	NA	NA	NA
Formetanate Hydrochloride	023422-53-9	NA	NA	NA	NA	NA	NA	NA
Formothion	002540-82-1	NA	NA	NA	NA	NA	NA	NA
Formparanate	017702-57-7	NA	NA	NA	NA	NA	NA	NA
Fosthietan	021548-32-3	NA	NA	NA	NA	NA	NA	NA
Fuberidazole	003878-19-1	NA	NA	NA	NA	NA	NA	NA
Furan	000110-00-9	NA	NA	NA	NA	NA	NA	NA
Gallium	007440-55-3	NA	NA	NA	NA	NA	NA	NA
Gallium Trichloride	013450-90-3	NA	NA	NA	NA	NA	NA	NA
Germanium	007440-56-4	NA	NA	NA	NA	NA	NA	NA
Glycol Ethers		NA	NA	NA	NA	NA	NA	NA
HMX (Cyclotetramethylene Tetranitramine)	002691-41-0	NA	NA	NA	NA	NA	NA	NA
Heptachlor	000076-44-8	NA	0.5 A3 [s]	35 Ca	0.5 Ca LF [s]	NA	0.5 [s]	NA
Heptane, n-	000142-82-5	2050	1640	750 ppm	350	1800 (C) [e]	2000	NA
Hexachlorobenzene	000118-74-1	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	000087-68-3	NA	0.21 A2 [s]	Ca	0.24 Ca LF [s]	NA	NA	NA
Hexachlorocyclopentadiene	000077-47-4	NA	0.11	NA	0.1	NA	NA	NA
Hexachloroethane	000067-72-1	NA	9.7 A2 [s]	300 ppm Ca	10 Ca LF [s]	NA	10 [s]	NA
Hexamethylene-1,6-diisocyanate	000822-06-0	NA	0.034	NA	0.005 ppm	0.02 ppm (C) [f]	NA	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Hexamethylenediamine, N,N-dibutyl-	004835-11-4	NA	NA	NA	NA	NA	NA	NA
Hexamethylphosphoramide	000680-31-9	NA	A2 [s]	NA	Ca LF	NA	NA	NA
Hexane, n-	000110-54-3	NA	176	1100 ppm [w]	180	NA	1800	NA
Hexene, 1-	000592-41-6	3500	1760	NA	NA	NA	NA	NA
Hexene, cis-2-		NA	NA	NA	NA	NA	NA	NA
Hexene, trans-2-	004050-45-7	NA	NA	NA	NA	NA	NA	NA
Hydrazine	000302-01-2	NA	0.13 A2 [s]	50 ppm Ca	Ca LF	0.04 (C) [r]	1.3 [s]	NA
Hydrochloric Acid or (Hydrogen chloride)	007647-01-0	7.5 (C)	NA	50 ppm	NA	7 (C)	NA	7 (C)
Hydrocyanic Acid or (Hydrogen cyanide)	000074-90-8	5 (C) [s]	NA	50 ppm	NA [s]	5 ST [s]	11 [s]	NA
Hydrogen Chloride, Anhydrous	007647-01-0	7.5 (C)	NA	50 ppm	NA	7 (C)	NA	7 (C)
Hydrogen Fluoride (Hydrofluoric acid)	007664-39-3	2.6 (C)	NA	30 ppm	2.5	5 (C) [e]	3 ppm [aa]	NA
Hydrogen Peroxide (saturated)	007722-84-1	NA	1.4	75 ppm	1.4	NA	1.4	NA
Hydrogen Selenide	007783-07-5	NA	0.16	1 ppm	0.2	NA	0.2	NA
Hydrogen Sulfide	007783-06-4	21	14	100 ppm	NA	15 (C) [f]	NA	20 ppm (C) [bb,cc]
Hydroquinone	000123-31-9	NA	2	50	NA	2 (C) [e]	2	NA
Iodine	007553-56-2	NA	1.0 (C)	2 ppm	NA	1 (C)	NA	1 (C)
Iron	007439-89-6	NA	NA	NA	NA	NA	NA	NA
Iron (soluble salts)		NA	1.0	NA	1.0	NA	NA	NA
Iron, Pentacarbonyl-	013463-40-6	0.45	0.23	NA	NA	NA	NA	NA
Isobenzan	000297-78-9	NA	NA	NA	NA	NA	NA	NA
Isobutyronitrile	000078-82-0	NA	NA	NA	22	NA	NA	NA
Isocyanic Acid, 3,4-Dichlorophenyl Ester	000102-36-3	NA	NA	NA	NA	NA	NA	NA
Isodrin	000465-73-6	NA	NA	NA	NA	NA	NA	NA
Isofluorphate	000055-91-4	NA	NA	NA	NA	NA	NA	NA
Isophorone	000078-59-1	28 (C)	NA	200 ppm	23	NA	140	NA

Revision Date: 04/06/95

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Isophorone Diisocyanate	004098-71-9	NA	0.045	NA	0.045 [s]	0.18 ST [s]	NA	NA
Isoprene	000078-79-5	NA	NA	NA	NA	NA	NA	NA
Isopropyl Chloroformate	000108-23-6	NA	NA	NA	NA	NA	NA	NA
Isopropymethylpyrazolyl Dimethylcarbamate	000119-38-0	NA	NA	NA	NA	NA	NA	NA
Ketone, Bis(Chloromethyl)	000534-07-6	NA	NA	NA	NA	NA	NA	NA
Lactonitrile	000078-97-7	NA	NA	NA	NA	NA	NA	NA
Lead (Inorganic dusts and fume)		NA	0.15	100	0.1	NA	0.05 [q]	NA
Lead (inorganic)	007439-92-1	NA	0.15	100	0.1	NA	0.05 [q]	NA
Lead (metal)	007439-92-1	NA	0.15	100	0.1	NA	0.05 [q]	NA
Lead Azide	013424-46-9	NA	NA	NA	NA	NA	NA	NA
Lead Compounds (as Pb)		NA	0.15	NA	0.1	NA	0.05 [q]	NA
Lead Styphnate	015245-44-0	NA	NA	NA	NA	NA	NA	NA
Lead, Tetraethyl	000078-00-2	NA	0.1 [d,s]	40	0.075 [s]	NA	0.075 [s]	NA
Lead, Tetramethyl	000075-74-1	NA	0.15 [d,s]	40	0.075 [s]	NA	0.075 [s]	NA
Leptophos	021609-90-5	NA	NA	NA	NA	NA	NA	NA
Lewisite	000541-25-3	NA	NA	NA	NA	NA	NA	NA
Limonene, delta-	005989-27-5	NA	NA	NA	NA	NA	NA	NA
Lindane	000058-89-9	NA	0.5 [s]	50	0.5 [s]	NA	0.5 [s]	NA
Lithium Hydride	007580-67-8	NA	0.025	0.5	0.025	NA	0.025	NA
Magnesium	007439-95-4	NA	NA	NA	NA	NA	NA	NA
Magnesium Oxide (fume)	001309-48-4	NA	10	750	NA	NA	15 [m]	NA
Maleic Anhydride	000108-31-6	NA	1.0	10	1	NA	1	NA
Malononitrile	000109-77-3	NA	NA	NA	8	NA	NA	NA
Manganese	007439-96-5	NA	NA	500	1.0	3 ST	NA	5 (C)
Manganese (Dust and compounds)		NA	5	500	1.0	3 ST	NA	5 (C)

OCCUPATIONAL STANDARDS AND CRITERIA[s]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Manganese (fume)	007439-96-5	3	1	500	1.0	3 ST	NA	5 (C)
Manganese Compounds (as Mn)		NA	5	500	1.0	3 ST	NA	5 (C)
Manganese, Tricarbonyl Methylcyclopentadienyl	012108-13-3	NA	0.2 [s]	NA	NA	NA	NA	NA
Mechlorethamine	000051-75-2	NA	NA	NA	NA	NA	NA	NA
Mephosfolan	000950-10-7	NA	NA	NA	NA	NA	NA	NA
Mercuric Acetate	001600-27-7	NA	NA	NA	NA	NA	NA	NA
Mercuric Chloride	007487-94-7	NA	NA	NA	NA	NA	NA	NA
Mercuric Oxide	021908-53-2	NA	NA	NA	NA	NA	NA	NA
Mercury	007439-97-6	NA	0.025 A4 [s]	10	NA	0.1 (C) [s]	NA	0.1 (C)[bb]
Mercury (Alkyl compounds)		0.03[s]	0.01 [s]	2	0.01 [s]	0.03 ST [s]	0.01 [aa]	0.04 (C)[bb]
Mercury (Aryl & inorganic compounds)		NA	0.1 [s]	NA	NA	NA	NA	0.1 (C)[bb]
Mercury (Inorganic)		NA	0.025 A4 [s]	10	0.1 [s]	NA	NA	0.1 (C)[bb]
Mercury (vapor)	007439-97-6	NA	0.025 A4 [s]	10	0.05 [s]	NA	NA	0.1 (C)[bb]
Mercury Fulminate	000628-86-4	NA	NA	NA	NA	NA	NA	NA
Methacrolein Diacetate	010476-95-6	NA	NA	NA	NA	NA	NA	NA
Methacrylic Anhydride	000760-93-0	NA	NA	NA	NA	NA	NA	NA
Methacrylonitrile	000126-98-7	NA	2.7 [s]	NA	3 [s]	NA	NA	NA
Methacryloyl Chloride	000920-46-7	NA	NA	NA	NA	NA	NA	NA
Methacryloyloxyethyl Isocyanate	030674-80-7	NA	NA	NA	NA	NA	NA	NA
Methamidophos	010265-92-6	NA	NA	NA	NA	NA	NA	NA
Methane	000074-82-8	NA	NA	NA	NA	NA	NA	NA
Methanesulfonyl Fluoride	000558-25-8	NA	NA	NA	NA	NA	NA	NA
Methanol	000067-56-1	328[s]	262 [s]	6000 ppm	260 [s]	325 ST [s]	260	NA
Methidathion	000950-37-8	NA	NA	NA	NA	NA	NA	NA
Methiocarb	002032-65-7	NA	NA	NA	NA	NA	NA	NA

Revision Date: 04/06/95

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m³)	ACGIH TWA* (mg/m³)	NIOSH IDLH (mg/m³)	NIOSH TWA** (mg/m³)	NIOSH STEL/C (mg/m³)	OSHA TWA* (mg/m³)	OSHA STEL/C (mg/m³)
Methicarb	001129-41-5	NA	NA	NA	NA	NA	NA	NA
Methomyl	016752-77-5	NA	2.5	NA	2.5	NA	NA	NA
Methoxychlor	000072-43-5	NA	10	5000 Ca	Ca LF	NA	15 [m]	NA
Methoxyethylmercuric Acetate	000151-38-2	NA	NA	NA	NA	NA	NA	NA
Methyl 2-Chloroacrylate	000080-63-7	NA	NA	NA	NA	NA	NA	NA
Methyl Bromide (Bromomethane)	000074-83-9	NA	19 [s]	250 ppm Ca	Ca LF	NA	NA	80 (C) [s]
Methyl Chloride (Chloromethane)	000074-87-3	207 [s]	103 [s]	2000 ppm Ca	Ca LF	NA	100 ppm [aa]	200 ppm (C) [bb,cc]
Methyl Chloroformate	000079-22-1	NA	NA	NA	NA	NA	NA	NA
Methyl Ethyl Ketone (2-Butanone)	000078-93-3	885	590	3000 ppm	590	300 ST	590	NA
Methyl Hydrazine	000060-34-4	0.38(C)A2 [s]	NA	20 ppm Ca	Ca LF	0.08 (C) [r]	NA	0.35 (C) [s]
Methyl Iodide (Iodomethane)	000074-88-4	NA	12 A2 [s]	100 ppm Ca	10 Ca LF [s]	NA	28 [s]	NA
Methyl Isobutyl Ketone (Hexone)	000108-10-1	307	205	500 ppm	205	300 ST	410	NA
Methyl Isocyanate	000624-83-9	NA	0.047 [s]	3 ppm	0.05 [s]	NA	0.05 [s]	NA
Methyl Isothiocyanate	000556-61-6	NA	NA	NA	NA	NA	NA	NA
Methyl Mercaptan	000074-93-1	NA	0.98	150 ppm	NA	1.0 (C) [e]	NA	20 (C)
Methyl Methacrylate	000080-62-6	NA	410	1000 ppm	410	NA	410	NA
Methyl Phenkapton	003735-23-7	NA	NA	NA	NA	NA	NA	NA
Methyl Phosphonic Dichloride	000676-97-1	NA	NA	NA	NA	NA	NA	NA
Methyl Tert Butyl Ether	001634-04-4	NA	NA	NA	NA	NA	NA	NA
Methyl Thiocyanate	000556-64-9	NA	NA	NA	NA	NA	NA	NA
Methyl Vinyl Ketone	000078-94-4	NA	NA	NA	NA	NA	NA	NA
Methyl chloroform (1,1,1-Trichloroethane)	000071-55-6	2460	1910	700 ppm	NA	1900 (C) [e]	1900	NA
Methyl-1-Butene, 2-	000563-46-2	NA	NA	NA	NA	NA	NA	NA
Methyl-1-Butene, 3-	000563-45-1	NA	NA	NA	NA	NA	NA	NA
Methyl-1-Pentene, 2-	000763-29-1	NA	NA	NA	NA	NA	NA	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m³)	ACGIH TWA* (mg/m³)	NIOSH IDLH (mg/m³)	NIOSH TWA** (mg/m³)	NIOSH STEL/C (mg/m³)	OSHA TWA* (mg/m³)	OSHA STEL/C (mg/m³)
Methyl-1-Pentene, 4-	000691-37-2	NA	NA	NA	NA	NA	NA	NA
Methyl-2-Butene, 2-	000513-35-9	NA	NA	NA	NA	NA	NA	NA
Methyl-2-Pentene, 2-	000625-27-4	NA	NA	NA	NA	NA	NA	NA
Methylcyclohexane	000108-87-2	NA	1610	1200 ppm[w]	1600	NA	2000	NA
Methylcyclopentane	000096-37-7	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride (Dichloromethane)	000075-09-2	NA	174, A2	2300 ppm Ca	Ca LF	NA	500 ppm[aa]	1000 ppm (C)[bb,cc]
Methylene Diphenyl Diisocyanate (MDI)	000101-68-8	NA	0.051	75	0.05	0.2 (C)[f]	NA	0.2 (C)
Methylene bis(2-chloroaniline), 4,4'-	000101-14-4	NA	0.11, A2[s]	NA	0.003 Ca LF[s]	NA	NA	NA
Methylenedianiline, 4,4'-	000101-77-9	NA	0.81, A2[s]	Ca	Ca LF	NA	NA	NA
Methylheptane, 2-		NA	NA	NA	NA	NA	NA	NA
Methylhexane, 3-	000589-34-4	NA	NA	NA	NA	NA	NA	NA
Methylhydantoin, 5-Ethyl-1,3-diglycidyl-5-	000592-27-8	NA	NA	NA	NA	NA	NA	NA
Methylmercuric Dicyanamide	000502-39-6	NA	NA	NA	NA	NA	NA	NA
Methylnaphthalene, 2-	000091-57-6	NA	NA	NA	NA	NA	NA	NA
Methylpentane, 2-	000107-83-5	NA	NA	NA	NA	NA	NA	NA
Methylpentane, 3-	000096-14-0	NA	NA	NA	NA	NA	NA	NA
Methyltrichlorosilane	000075-79-6	NA	NA	NA	NA	NA	NA	NA
Methytlnaphthalene, 1-	001321-94-4	NA	NA	NA	NA	NA	NA	NA
Mevinphos (Phosdrin)	007786-34-7	0.27[s]	0.092[s]	4 ppm	0.1[s]	0.3 ST[s]	0.1[s]	NA
Mexacarbate	000315-18-4	NA	NA	NA	NA	NA	NA	NA
Mineral fibers		NA	NA	NA	5[z]	NA	NA	NA
Mitomycin C	000050-07-7	NA	NA	NA	NA	NA	NA	NA
Molybdenum	007439-98-7	NA	NA	5000	NA	NA	15[m]	NA
Molybdenum (Insoluble compounds)		NA	10	5000	NA	NA	15[m]	NA
Molybdenum (Soluble compounds)		NA	5	1000	NA	NA	5	NA

Revision Date: 04/06/95

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA[a] (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA[a,a] (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA[a] (mg/m^3)	OSHA STEL/C (mg/m^3)
Monocrotophos	006923-22-4	NA	0.25[s]	NA	0.25	NA	NA	NA
Monoethylamine (Ethylamine)	000075-04-7	27.6[s]	9.2[s]	600 ppm	18	NA	18	NA
Muscimol	002763-94-4	NA	NA	NA	NA	NA	NA	NA
Mustard Gas	000505-60-2	NA	NA	NA	NA	NA	NA	NA
Myrcene	000123-35-3	NA	NA	NA	NA	NA	NA	NA
Naphthalene	000091-20-3	79	52	250 ppm	50	75 ST	50	NA
Naphthaleneamine, 2-		NA	NA	NA	NA	NA	NA	NA
Naphthylamine, 2-	000091-59-8	NA	A1	Ca	Ca LF	NA	Ca[d,q]	NA
Nickel	007440-02-0	NA	1.0	10 Ca	0.015 Ca LF	NA	1.0	NA
Nickel (Metal)	007440-02-0	NA	1.0	10 Ca	0.015 Ca LF	NA	1.0	NA
Nickel (Refinery dust)	007440-02-0	NA	NA	NA	NA	NA	NA	NA
Nickel (Soluble compounds)		NA	0.1	NA	NA	NA	1.0	NA
Nickel (Soluble salts)		NA	NA	NA	NA	NA	NA	NA
Nickel Carbonyl	013463-39-3	NA	0.12	2 ppm Ca	0.007 Ca LF	NA	0.007	NA
Nicotine	000054-11-5	NA	0.5[s]	5	0.5[s]	NA	0.5[s]	NA
Nicotine Sulfate	000065-30-5	NA	NA	NA	NA	NA	NA	NA
Nitric Acid	007697-37-2	10	5.2	25 ppm	5	10 ST	5	NA
Nitric Oxide	010102-43-9	NA	31	100 ppm	30	NA	30	NA
Nitrobenzene	000098-95-3	NA	5[s]	200 ppm	5[s]	NA	5[s]	NA
Nitrobiphenyl, 4- (or 4-Nitrodiphenyl)	000092-93-3	NA	A1[s]	Ca	Ca LF	NA	Ca[q]	NA
Nitrocellulose	009004-70-0	NA	NA	NA	NA	NA	NA	NA
Nitrocyclohexane	001122-60-7	NA	NA	NA	NA	NA	NA	NA
Nitrodiphenylamine, 2-	000199-75-5	NA	NA	NA	NA	NA	NA	NA
Nitrodiphenylamine, 4-	000836-30-6	NA	NA	NA	NA	NA	NA	NA
Nitrogen Dioxide	010102-44-0	9.4	5.6	20 ppm	1.8	NA	NA	9.0 (C)

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Nitroglycerine	000055-63-0	NA	0.46 [s]	75	NA	0.1 ST [s]	NA	2 (C) [s]
Nitroguanidine	000556-88-7	NA	NA	NA	NA	NA	NA	NA
Nitromethane	000075-52-5	NA	50	750 ppm	NA	NA	250	NA
Nitronaphthalene, 2-	000581-89-5	NA	NA	Ca	Ca LF	NA	NA	NA
Nitrophenol, 4-	000100-02-7	NA	NA	NA	NA	NA	NA	NA
Nitrophenol, o-	000088-75-5	NA	NA	NA	NA	NA	NA	NA
Nitropropane, 2-	000079-46-9	NA	36 A2	100 ppm Ca	Ca LF	NA	90	NA
Nitropyrene, 1-		NA	NA	NA	NA	NA	NA	NA
Nitroso-N-methylurea, N-	000684-93-5	NA	NA	NA	NA	NA	NA	NA
Nitrosochethylamine, N-		NA	NA	NA	NA	NA	NA	NA
Nitrosodimethylamine, N-	000062-75-9	NA	A2 [s]	Ca	Ca LF	NA	Ca [q]	NA
Nitrosodiphenylamine, 4-	000156-10-5	NA	NA	NA	NA	NA	NA	NA
Nitrosodiphenylamine, N-	000086-30-6	NA	NA	NA	NA	NA	NA	NA
Nitrosomorpholine, N-	000059-89-2	NA	NA	NA	NA	NA	NA	NA
Nonane, n-	000111-84-2	NA	1050	NA	1050	NA	NA	NA
Norbormide	000991-42-4	NA	NA	NA	NA	NA	NA	NA
Octane, n-	000111-65-9	1750	1400	1000 ppm [w]	350	1800 (C) [e]	2350	NA
Organorthodium Complex (PMN-92-147)		NA	NA	NA	NA	NA	NA	NA
Ouabain	000630-60-4	NA	NA	NA	NA	NA	NA	NA
Oxamyl	023135-22-0	NA	NA	NA	NA	NA	NA	NA
Oxetane, 3,3-Bis(chloromethyl)-	000078-71-7	NA	NA	NA	NA	NA	NA	NA
Oxydisulfoton	002497-07-6	NA	NA	NA	NA	NA	NA	NA
Ozone	010028-15-6	0.2 (C)	NA	5 ppm	0.2	NA	0.2	NA
Paraquat	004685-14-7	NA	0.1 [g]	NA	NA	NA	0.5 [g,s]	NA
Paraquat Methosulfate	002074-50-2	NA	NA	NA	NA	NA	0.5 [g,s]	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Parathion	000056-38-2	NA	0.1 [s]	10	0.05 [s]	NA	0.1 [s]	NA
Parathion, Methyl	000298-00-0	NA	0.2 [s]	NA	0.2 [s]	NA	NA	NA
Paris Green	012002-03-8	NA	NA	NA	NA	NA	NA	NA
Particulates (PM10)		NA	10	NA	NA	NA	5 [g]	NA
Particulates (PM10, total dust)		NA	10 [b]	NA	NA	NA	15	NA
Pentaborane	019624-22-7	0.039	0.013	1 ppm	0.01	0.03 ST	0.01	NA
Pentachloronitrobenzene (Quintobenzene)	000082-68-8	NA	0.5	NA	NA	NA	NA	NA
Pentachlorophenol	000087-86-5	NA	0.5 [s]	2.5	0.5 [s]	NA	0.5 [s]	NA
Pentadecylamine	002570-26-5	NA	NA	NA	NA	NA	NA	NA
Pentaerythritol Tetranitrate (PETN)	000078-11-5	NA	NA	NA	NA	NA	NA	NA
Pentene	025377-72-4	NA	NA	NA	NA	NA	NA	NA
Pentene, 1-	000109-67-1	NA	NA	NA	NA	NA	NA	NA
Pentene, cis-2-	000627-20-3	NA	NA	NA	NA	NA	NA	NA
Pentene, trans-2-	000646-04-8	NA	NA	NA	NA	NA	NA	NA
Peracetic Acid	000079-21-0	NA	NA	NA	NA	NA	NA	NA
Perchloromethylmercaptan	000594-42-3	NA	0.76	10 ppm	0.8	NA	0.8	NA
Phenanthrene	000085-01-8	NA	NA	NA	NA	NA	NA	NA
Phenol	000108-95-2	NA	19 [s]	250 ppm	19 [s]	60 (C) [e,s]	19 [s]	NA
Phenol, 2,2 Thiobis(4-chloro-6-methyl)-	004418-66-0	NA	NA	NA	NA	NA	NA	NA
Phenol, 3-(1 Methylethyl)-, Methylcarbamate	000064-00-6	NA	NA	NA	NA	NA	NA	NA
Phenoxarsine, 10, 10-Oxydi-	000058-36-6	NA	NA	NA	NA	NA	NA	NA
Phenyl Dichloroarsine	000696-28-6	NA	NA	NA	NA	NA	NA	NA
Phenyldiisodecyl Phosphite		NA	NA	NA	NA	NA	NA	NA
Phenylenediamine, p	000106-50-3	NA	0.1	25	0.1 [s]	NA	0.1 [s]	NA
Phenylhydrazine Hydrochloride	000059-88-1	NA	NA	NA	NA	NA	NA	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Phenylmercury Acetate	000062-38-4	NA	NA	NA	NA	NA	NA	NA
Phenylsilatrane	002097-19-0	NA	NA	NA	NA	NA	NA	NA
Phenylthiourea	000103-85-5	NA	NA	NA	NA	NA	NA	NA
Phorate	000298-02-2	0.2[s]	0.05[s]	NA	0.05[s]	0.2 ST[s]	NA	NA
Phosacetim	004104-14-7	NA	NA	NA	NA	NA	NA	NA
Phosfolan	000947-02-4	NA	NA	NA	NA	NA	NA	NA
Phosgene	000075-44-5	NA	0.40	2 ppm	0.4	0.8 (C)[e]	0.4	NA
Phosmet	000732-11-6	NA	NA	NA	NA	NA	NA	NA
Phosphamidon	013171-21-6	NA	NA	NA	NA	NA	NA	NA
Phosphine	007803-51-2	1.4	0.42	50 ppm	0.4	1.0 ST	0.4	NA
Phosphonothioic Acid, Methyl-, O-(4-nitrophenyl) O-phenyl ester	002665-30-7	NA	NA	NA	NA	NA	NA	NA
Phosphonothioic Acid, Methyl-, O-ethyl O-(4-(methylthio)phenyl) ester	002703-13-1	NA	NA	NA	NA	NA	NA	NA
Phosphonothioic Acid, Methyl-, S-(2-(Bis(1-methylethyl)amino)ethyl O-ethyl ester	050782-69-9	NA	NA	NA	NA	NA	NA	NA
Phosphoric Acid, Dimethyl 4-(methylthio) phenyl ester	003254-63-5	NA	NA	NA	NA	NA	NA	NA
Phosphorothioic Acid, O,O-Dimethyl-S-(2-methylthio)ethyl ester	002587-90-8	NA	NA	NA	NA	NA	NA	NA
Phosphorus	007723-14-0	NA	0.1	5	0.1	NA	0.1	NA
Phosphorus (white, yellow)	007723-14-0	NA	0.1	5	0.1	NA	0.1	NA
Phosphorus Oxychloride	010025-87-3	NA	0.63	NA	0.06	3 ST	NA	NA
Phosphorus Pentachloride	010026-13-8	NA	0.85	70	1	NA	1	NA
Phosphorus Pentoxide	001314-56-3	NA	NA	NA	NA	NA	NA	NA
Phosphorus Trichloride	007719-12-2	2.8	1.1	25 ppm	1.5	NA	3	NA
Phthalic Anhydride	000085-44-9	NA	6.1	60	6	NA	12	NA

Revision Date: 04/06/95

OCCUPATIONAL STANDARDS AND CRITERIA[*]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Physostigmine	000057-47-6	NA	NA	NA	NA	NA	NA	NA
Physotigmine, Salicylate (1:1)	000057-64-7	NA	NA	NA	NA	NA	NA	NA
Picric acid	000088-89-1	NA	0.1	75	0.1 [s]	0.3 [s]	0.1 [s]	NA
Picrotoxin	000124-87-8	NA	NA	NA	NA	NA	NA	NA
Pinene, alpha-	000080-56-8	NA	NA	NA	NA	NA	NA	NA
Pinene, beta-	000127-91-3	NA	NA	NA	NA	NA	NA	NA
Piperidine	000110-89-4	NA	NA	NA	NA	NA	NA	NA
Pirimifos, Ethyl	023505-41-1	NA	NA	NA	NA	NA	NA	NA
Polychlorinated Biphenyls (Aroclors)	001336-36-3	NA	NA	NA	NA	NA	NA	NA
Polycylic Organic Matter		NA	NA	NA	NA	NA	NA	NA
Polystyrene	009003-53-6	NA	NA	NA	NA	NA	NA	NA
Potassium	007440-09-7	NA	NA	NA	NA	NA	NA	NA
Potassium Arsenide	010124-50-2	NA	NA	NA	NA	NA	NA	NA
Potassium Cyanide	000151-50-8	NA	NA	25 [h]	NA	5 (C) [f]	NA	NA
Potassium Hydroxide	001310-58-3	2 (C)	NA	NA	2	NA	NA	NA
Potassium Nitrate	007757-79-1	NA	NA	NA	NA	NA	NA	NA
Potassium Silver Cyanide	000506-61-6	NA	NA	NA	NA	NA	NA	NA
Promecarb	002631-37-0	NA	NA	NA	NA	NA	NA	NA
Propane	000074-98-6	NA	NA	2100 ppm [w]	1800	NA	1800	NA
Propane Sultone, 1,3-	001120-71-4	NA	A2	NA	Ca LF	NA	NA	NA
Propargyl Bromide	000106-96-7	NA	NA	NA	NA	NA	NA	NA
Propiolactone, Beta-	000057-57-8	NA	1.5 A2	Ca	Ca LF	NA	Ca [q]	NA
Propionaldehyde	000123-38-6	NA	NA	NA	NA	NA	NA	NA
Propionitrile	000107-12-0	NA	NA	NA	14	NA	NA	NA
Propionitrile, 3-Chloro-	000542-76-7	NA	NA	NA	NA	NA	NA	NA

Revision Date: 04/06/95

OCCUPATIONAL STANDARDS AND CRITERIA *

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Propiophenone, 4-Amino-	000070-69-9	NA	NA	NA	NA	NA	NA	NA
Propoxur (Baygon)	000114-26-1	NA	0.5	NA	0.5	NA	NA	NA
Propyl Adipate, di-N-	000106-19-4	NA	NA	NA	NA	NA	NA	NA
Propyl Chloroformate	000109-61-5	NA	NA	NA	NA	NA	NA	NA
Propylbenzene, 1-	000103-65-1	NA	NA	NA	NA	NA	NA	NA
Propylene Dichloride (1,2-Dichloropropane)	000078-87-5	508	347	400 ppm Ca	Ca LF	NA	350	NA
Propylene Oxide	000075-56-9	NA	48	400 ppm Ca	Ca LF	NA	240	NA
Propyleneimine	000075-55-8	NA	4.7 A2 *	100 ppm Ca	5 Ca LF *	NA	5 *	NA
Prothoate	002275-18-5	NA	NA	NA	NA	NA	NA	NA
Pyrene	000129-00-0	NA	NA	NA	NA	NA	NA	NA
Pyridine, 2-Methyl-5-Vinyl-	000140-76-1	NA	NA	NA	NA	NA	NA	NA
Pyridine, 4-Amino-	000504-24-5	NA	NA	NA	NA	NA	NA	NA
Pyridine, 4-Nitro-, 1-Oxide	001124-33-0	NA	NA	NA	NA	NA	NA	NA
Pyriminil	053558-25-1	NA	NA	NA	NA	NA	NA	NA
Quinoline	000091-22-5	NA	NA	NA	NA	NA	NA	NA
Quinone	000106-51-4	NA	0.44	100	0.4	NA	0.4	NA
RDX (Cyclo-1,3,5-trimethylene-2,4,6-trinitramine)	000121-82-4	NA	1.5 *	NA	1.5	3 ST *	NA	NA
Radionuclides (Includes radon, See entries for specific compounds)		NA	NA	NA	NA	NA	NA	NA
Resorcinol	000108-46-3	90	45	NA	45	90 ST	NA	NA
Salane, (4-Aminobutyl)diethoxymethyl-	003037-72-7	NA	NA	NA	NA	NA	NA	NA
Salcomine	014167-18-1	NA	NA	NA	NA	NA	NA	NA
Salicylic Acid	000069-72-7	NA	NA	NA	NA	NA	NA	NA
Sarin	000107-44-8	NA	NA	NA	NA	NA	NA	NA
Selenious Acid	007783-00-8	NA	NA	NA	0.2	NA	0.2	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Selenium	007782-49-2	NA	0.2	1	0.2	NA	0.2	NA
Selenium Compounds (as Se)		NA	0.2	1	0.2	NA	0.2	NA
Selenium Oxychloride	007791-23-3	NA	NA	NA	0.2	NA	0.2	NA
Semicarbazide Hydrochloride	000563-41-7	NA	NA	NA	NA	NA	NA	NA
Silane, Trichloro(chloromethyl)-	001558-25-4	NA	NA	NA	NA	NA	NA	NA
Silane, Trichloro(dichloropheny)-	027137-85-5	NA	NA	NA	NA	NA	NA	NA
Silicon	007440-21-3	NA	10 [b]	NA	5 [g]	NA	5 [g]	NA
Silicon (Total dust)	007440-21-3	NA	10 [b]	NA	10 [m]	NA	15	NA
Silver (Metal dust and fume)	007440-22-4	NA	NA	NA	NA	NA	0.01	NA
Silver (Metal dust and soluble compounds)		NA	NA	10	0.01	NA	NA	NA
Silver (Metal dust, soluble compounds, and fumes)		NA	0.01	NA	NA	NA	0.01	NA
Silver (Soluble compounds)		NA	0.01	10	0.01	NA	NA	NA
Silver (metal)	007440-22-4	NA	0.1	10	0.01	NA	NA	NA
Sodium Arsenate	007631-89-2	NA	NA	NA	NA	NA	NA	NA
Sodium Arsenite	007784-46-5	NA	NA	NA	NA	NA	NA	NA
Sodium Azide	026628-22-8	0.29 (C)	NA	NA	NA	0.3 (C) [s]	NA	NA
Sodium Cacodylate	000124-65-2	NA	NA	NA	NA	NA	NA	NA
Sodium Cyanide	000143-33-9	NA	NA	25	NA	5 (C) [f]	NA	NA
Sodium Fluoroacetate	000062-74-8	NA	0.05 [s]	2.5	NA	0.15 ST [s]	0.05 [s]	NA
Sodium Nitrate	007631-99-4	NA	NA	NA	NA	NA	NA	NA
Sodium Selenate	013410-01-0	NA	NA	NA	NA	NA	NA	NA
Sodium Selenite	010102-18-8	NA	NA	NA	NA	NA	NA	NA
Sodium Tellurite	010102-20-2	NA	NA	NA	NA	NA	NA	NA
Stannane, Acetoxytriphenyl-	000900-95-8	NA	NA	NA	NA	NA	NA	NA
Strontium	007440-24-6	NA	NA	NA	NA	NA	NA	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Strychnine	000057-24-9	NA	0.15	3	0.15	NA	0.15	NA
Strychnine Sulfate	000060-41-3	NA	NA	NA	NA	NA	NA	NA
Styrene	000100-42-5	426[s]	213[s]	700 ppm	215	425 ST	100 ppm[aa]	200 ppm (C)[bb,cc]
Styrene Oxide	000096-09-3	NA	NA	NA	NA	NA	NA	NA
Sulfotep (Tetraethyldithiopyrophosphate or TEDP)	003689-24-5	NA	0.2[s]	10	0.2[s]	NA	0.2[s]	NA
Sulfoxide, 3-Chloropropyl octyl	003569-57-1	NA	NA	NA	NA	NA	NA	NA
Sulfur	007704-34-9	NA	NA	NA	NA	NA	NA	NA
Sulfur Dioxide	007446-09-5	13	5.2	100 ppm	5	13 ST	13	NA
Sulfur Dioxide, Anhydrous		NA	NA	NA	NA	NA	NA	NA
Sulfur Tetrafluoride	007783-60-0	0.44 (C)	NA	NA	NA	0.4 (C)	NA	NA
Sulfur Trioxide	007446-11-9	NA	NA	NA	NA	NA	NA	NA
Sulfuric Acid	007664-93-9	3	1	15	1	NA	1	NA
TEPP	000107-49-3	NA	0.047[s]	5	0.05[s]	NA	0.05[s]	NA
Tabun	000077-81-6	NA	NA	NA	NA	NA	NA	NA
Tellurium	013494-80-9	NA	0.1	25	0.1	NA	0.1	NA
Tellurium Hexafluoride	007783-80-4	NA	0.10	1 ppm	0.2	NA	0.2	NA
Terbufos	013071-79-9	NA	NA	NA	NA	NA	NA	NA
Terpinene, alpha-	000099-86-5	NA	NA	NA	NA	NA	NA	NA
Terpinene, delta-		NA	NA	NA	NA	NA	NA	NA
Terpinolene	000586-62-9	NA	NA	NA	NA	NA	NA	NA
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	001746-01-6	NA	NA	NA	Ca LF	NA	NA	NA
Tetrachloroethane, 1,1,2,2-	000079-34-5	NA	6.9[s]	100 ppm Ca	7 Ca LF[s]	NA	35[s]	NA
Tetrachloroethylene (Perchloroethylene)	000127-18-4	685 A3	170 A3	150 ppm Ca	Ca LF	NA	100 ppm[aa]	200 ppm (C)[bb,cc]
Tetranitromethane	000509-14-8	NA	0.04 A2	4 ppm	8	NA	8	NA
Tetryl (Trinitro-2,4-6-phenylmethylnitramine)	000479-45-8	NA	1.5	750	1.5[s]	NA	1.5[s]	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA[a] (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA[a a] (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA[a] (mg/m^3)	OSHA STEL/C (mg/m^3)
Thallium Sulfate	010031-59-1	NA	NA	NA	NA	NA	NA	NA
Thallous Carbonate	006533-73-9	NA	NA	NA	NA	NA	NA	NA
Thallous Chloride	007791-12-0	NA	NA	NA	NA	NA	NA	NA
Thallous Malonate	002757-18-8	NA	NA	NA	NA	NA	NA	NA
Thallous Sulfate	007446-18-6	NA	NA	NA	NA	NA	NA	NA
Thiocarbazide	002231-57-4	NA	NA	NA	NA	NA	NA	NA
Thiofanox	039196-18-4	NA	NA	NA	NA	NA	NA	NA
Thionazin	000297-97-2	NA	NA	NA	NA	NA	NA	NA
Thiophenol	000108-98-5	NA	NA	NA	NA	NA	NA	NA
Thiosemicarbazide	000079-19-6	NA	NA	NA	NA	NA	NA	NA
Thiourea, (2-Chlorophenyl)-	005344-82-1	NA	NA	NA	NA	NA	NA	NA
Thiourea, (2-Methylphenyl)-	000614-78-8	NA	NA	NA	NA	NA	NA	NA
Tin (Metal)	007440-31-5	NA	2	100	2	NA	2	NA
Tin (Organic compounds)		0.2[s]	0.1[s]	25	0.1[s]	NA	0.1	NA
Tin (Oxide and inorganic compounds except SnH4)		NA	2	NA	2	NA	NA	NA
Tin (and compounds)		NA	NA	NA	NA	NA	NA	NA
Tin (inorganic compounds except oxides)	007440-31-5	NA	NA	100	2	NA	2	NA
Tin, Tetraethyl	000597-64-8	NA	NA	NA	NA	NA	NA	NA
Titanium	007440-32-6	NA	NA	NA	NA	NA	NA	NA
Titanium Tetrachloride	007550-45-0	NA	NA	NA	NA	NA	NA	NA
Toluene	000108-88-3	NA	188[s]	500 ppm	375	560 ST	200 ppm[aa]	300 ppm (C)[bb,cc]
Toluene 2,6-Diisocyanate	000091-08-7	NA	NA	NA	NA	NA	NA	NA
Toluene Diamine, 2,4-	000095-80-7	NA	NA	Ca	Ca LF	NA	NA	NA
Toluene Diisocyanate	026471-62-5	NA	NA	NA	NA	NA	NA	NA
Toluene, 2,4-Diisocyanate	000584-84-9	0.14	0.036	2.5 ppm,Ca	Ca LF	NA	NA	0.14 (C)

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Toluidine, o-	000095-53-4	NA	8.8 A2 [s]	50 ppm Ca	Ca LF [s]	NA	22 [s]	NA
Toxaphene (Chlorinated camphene)	008001-35-2	1 [s]	0.5 [s]	200 Ca	Ca LF [s]	NA	0.5 [s]	NA
Triacetin	000102-76-1	NA	NA	NA	NA	NA	NA	NA
Triamiphos	001031-47-6	NA	NA	NA	NA	NA	NA	NA
Triazofos	024017-47-8	NA	NA	NA	NA	NA	NA	NA
Trichloroacetyl Chloride	000076-02-8	NA	NA	NA	NA	NA	NA	NA
Trichlorobenzene, 1,2,4-	000120-82-1	37 (C)	NA	NA	NA	40 (C)	NA	NA
Trichloroethane, 1,1,2-	000079-00-5	NA	55 [s]	100 ppm Ca	45 Ca LF [s]	NA	45 [s]	NA
Trichloroethylene	000079-01-6	537 A5	269 A5	1000 ppm Ca	Ca LF	NA	100 ppm [aa]	200 ppm (C) [bb,cc]
Trichloroethylsilane	000115-21-9	NA	NA	NA	NA	NA	NA	NA
Trichloronate	000327-98-0	NA	NA	NA	NA	NA	NA	NA
Trichlorophenol, 2,4,5-	000095-95-4	NA	NA	NA	NA	NA	NA	NA
Trichlorophenol, 2,4,6-	000088-06-2	NA	NA	NA	NA	NA	NA	NA
Trichlorophenylsilane	000098-13-5	NA	NA	NA	NA	NA	NA	NA
Triethoxysilane	000998-30-1	NA	NA	NA	NA	NA	NA	NA
Triethylamine	000121-44-8	20.7 [s]	4.1 [s]	200 ppm	NA	NA	100	NA
Trifluralin	001582-09-8	NA	NA	NA	NA	NA	NA	NA
Trimethyl-3-phenylindane, 1,1,3-	003910-35-8	NA	NA	NA	NA	NA	NA	NA
Trimethylbenzene, 1,2,4-	000095-63-6	NA	NA	NA	125	NA	NA	NA
Trimethylbenzene, 1,3,5-	000108-67-8	NA	NA	NA	125	NA	NA	NA
Trimethylchlorosilane	000075-77-4	NA	NA	NA	NA	NA	NA	NA
Trimethylolpropane Phosphite	000824-11-3	NA	NA	NA	NA	NA	NA	NA
Trimethylpentane, 2,2,3-	054665-47-3	NA	NA	NA	NA	NA	NA	NA
Trimethylpentane, 2,2,4-	000540-84-1	NA	NA	NA	NA	NA	NA	NA
Trimethylpentane, 2,3,4-	000565-75-3	NA	NA	NA	NA	NA	NA	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m^3)	ACGIH TWA* (mg/m^3)	NIOSH IDLH (mg/m^3)	NIOSH TWA** (mg/m^3)	NIOSH STEL/C (mg/m^3)	OSHA TWA* (mg/m^3)	OSHA STEL/C (mg/m^3)
Trimethyltin Chloride	001066-45-1	NA	NA	NA	NA	NA	NA	NA
Trinitroanisole	028653-16-9	NA	NA	NA	NA	NA	NA	NA
Trinitrobenzene, 1,3,5-	000099-35-4	NA	NA	NA	NA	NA	NA	NA
Trinitroglycerol	000055-63-0	NA	NA	NA	NA	NA	NA	NA
Trinitrotoluene, 2,4,6-	000118-96-7	NA	0.5 [s]	500	0.5 [s]	NA	1.5 [s]	NA
Triphenyltin Chloride	000639-58-7	NA	NA	NA	NA	NA	NA	NA
Tris(2-Chloroethyl) Amine	000555-77-1	NA	NA	NA	NA	NA	NA	NA
Uranium	007440-61-1	0.6	0.2	10 Ca	0.2 Ca LF	0.6 ST	0.25	NA
Uranium (Insoluble compounds)		0.6	0.2	10 Ca	0.2, Ca LF	0.6 ST	0.25	NA
Uranium (Natural)	007440-61-1	0.6	0.2	NA	NA	NA	NA	NA
Uranium (Soluble and insoluble compounds)		0.6	0.2	NA	NA	NA	NA	NA
Uranium (Soluble compounds)		0.6	0.2	10 Ca	0.05 Ca LF	NA	0.05	NA
Uranium Soluble Salts		NA	NA	10 Ca	0.05 Ca LF	NA	NA	NA
Valinomycin	002001-95-8	NA	NA	NA	NA	NA	NA	NA
Vanadium	007440-62-2	NA	NA	NA	NA	NA	NA	NA
Vanadium Pentoxide (as V2O5)	001314-62-1	NA	0.05 [g]	35 [g]	NA	0.05 (C) [e,g]	NA	0.1 (C) [k]
Vinyl Acetate	000108-05-4	53 A3	35 A3	NA	NA	15 (C) [e]	NA	NA
Vinyl Bromide	000593-60-2	NA	22 A2	Ca	Ca LF	NA	NA	NA
Vinyl Chloride	000075-01-4	NA	13 A1	Ca	1 ppm Ca LF [q]	5 ppm ST [q]	1 ppm Ca [q]	0.1 (C) [q]
Vinylidene Chloride (1,1-Dichloroethylene)	000075-35-4	79	20	Ca	Ca LF	NA	NA	NA
Warfarin	000081-81-2	NA	0.1	100	0.1	NA	0.1	NA
Warfarin, Sodium	000129-06-6	NA	NA	NA	NA	NA	NA	NA
Xylene (all isomers)	001330-20-7	651 [j]	434 [j]	900 ppm [j]	435 [j]	655 [j]	435 [j]	NA
Xylene Dichloride	028347-13-9	NA	NA	NA	NA	NA	NA	NA
Xylene, m-	000108-38-3	651 [j]	434 [j]	900 ppm [j]	435 [j]	655 ST [j]	435 [j]	NA

OCCUPATIONAL STANDARDS AND CRITERIA[a]

Chemical	CAS Number	ACGIH STEL/C (mg/m³)	ACGIH TWA* (mg/m³)	NIOSH IDLH (mg/m³)	NIOSH TWA** (mg/m³)	NIOSH STEL/C (mg/m³)	OSHA TWA* (mg/m³)	OSHA STEL/C (mg/m³)
Xylene, o-	000095-47-6	651[j]	434[j]	900 ppm[j]	435[j]	655 ST[j]	435[j]	NA
Xylene, p-	000106-42-3	651[j]	434[j]	900 ppm[j]	435[j]	655 ST[j]	435[j]	NA
Xylenes (isomers and mixture)	001330-20-7	651[j]	434[j]	900 ppm[j]	435[j]	655[j]	435[j]	NA
Xylenes (isomers and mixture) -m	000108-38-3	651[j]	434[j]	900 ppm[j]	435[j]	655[j]	435[j]	NA
Xylenes (isomers and mixture) -o	000095-47-6	651[j]	434[j]	900 ppm[j]	435[j]	655[j]	435[j]	NA
Xylenes (isomers and mixture) -p	000106-42-3	651	434[j]	900 ppm[j]	435[j]	655[j]	435[j]	NA
Zinc (metallic)	007440-66-6	NA	NA	NA	NA	NA	NA	NA
Zinc Oxide (dust)	001314-13-2	NA	10[b]	500	5	15 (C)	5[g]	NA
Zinc Oxide (fume)	001314-13-2	10[k]	5[k]	500	5[g]	10 ST[k]	5[k]	NA
Zinc Phosphide	001314-84-7	NA	NA	NA	NA	NA	NA	NA
Zinc, Dichloro(4,4-dimethyl-5(((methylamino) carbonyl)oxy)imino)pentanenitrile)-(T-4)	058270-08-9	NA	NA	NA	NA	NA	NA	NA
Zirconium (and compounds)		10	5	50	5	10 ST	5	NA

A1 = Confirmed Human Carcinogen; A2 = Suspected Human Carcinogen; A3 = Carcinogenic in Experimental Animals; A5 = Not Suspected as a Human Carcinogen
(C) - Ceiling Value - should not be exceeded at any time; Ca = Potential Human Carcinogen; LD = Lowest Detectable Concentration; LF = Lowest Feasible.

NA = Not Available, ST (Short Term Exposure Limit) = 15 minute TWA exposure that should not be exceeded at any time during a workday. When Ca and LF appear together, use of only the most reliable and protective respirators is recommended.

[a] Results expressed as mg/m^3 unless otherwise noted
ACGIH Standards taken from American Conference of Governmental Industrial Hygienists, 1994-1995, Threshold Limit Values for Chemical Substances and Physical Physical Agents and Biological Exposure Indices.NIOSH Standards taken from NIOSH Pocket Guide to Chemical Hazards, June, 1994, and NIOSH Recommendations for Occupational Safety and Health Compendium of Policy Documents and Statements, 1992.
OSHA Standards taken from "Transitional Limits": column of Table Z-1-A and Table Z-2, final rule of January 19, 1989, 54 2332.

[b] Value is for total dust containing no asbestos and <1% crystalline silica
[d] For greater assurance of worker protection, biological monitoring is recommended.
[e] 15 minutes
[f] 10 minutes
[g] Respirable dust or fume
[h] Value is for total cyanides
[i] Value is for total anisidines; o- and p- isomers
[j] Value is for total xylenes
[k] Respirable fume
[m] Total dust
[n] Value is for total cresols
[p] 30 minutes
[q] OSHA has identified this chemical as a carcinogen; exposure of workers to this chemical must be controlled. See 29 CFR 1910.1003 - 1910.1045 for details of these requirements.
[r] Two hour
[s] Skin - indicates potential for dermal absorption; skin exposure should be prevented by the use of good work practices and protective clothing and gear.
[t] Simple asphyxiant
[u] Value is for total dinitrotoluenes
[v] Cyclohexane-extractable fraction
[w] IDLH is based on 10% of the lower explosive limit for safety considerations even though the relevant toxicological data indicated that irreversible health effects or impairment of escape existed only at higher concentrations.
[x] 60 minutes
[y] Value is for chromium III compounds, IDLH for chromium II compounds is 250 mg/m^3.
[z] Fibers less than or equal to 3.5 micrometers in diameter and greater than or equal to 10 micrometers in length.
[aa] See also OSHA Table Z-2
[bb] See also OSHA Table Z-2 for ceiling values
[cc] See also OSHA Table Z-2 for maximum acceptable peak concentrations for an 8-hour shift.

* TWA based on an 8-hour workday and a 40-hour work week.
** TWA based on up to a 10-hour workday and a 40-hour work week.

HEALTH AND ENVIRONMENTAL STANDARDS AND ADVISORY CRITERIA

SUPPLEMENTAL AIR TABLE

Prepared for:

Hazardous Waste Remedial Action Program

Prepared by:

Chemical Hazard Evaluation Group
Biomedical and Environmental Information Analysis Section
Health Sciences Research Division
Oak Ridge National Laboratory

April 1995

SUPPLEMENTAL TABLES FOR HEALTH AND ENVIRONMENTAL STANDARDS AND ADVISORY CRITERIA

The Supplemental Tables are compilations of standards and advisory criteria which can be used as a convenient reference guide to identify the most restrictive (i.e., conservative) exposure levels for specific exposure routes (air, water, soil), exposure periods (ceiling values, short-term, lifetime), and populations (e.g., children, adults, general public, occupational). This information is contained in two tables, one is specific for air contaminants, the other for water and soil contaminants.

SUPPLEMENTAL AIR TABLE

This table combines information on ACGIH, NIOSH, and OSHA exposure limits with EPA ambient air quality standards, RCRA action levels, RfC values and cancer unit risks and control limits. Descriptions of the endpoints are as follows (values are in $\mu g/m^3$, except for unit risk):

1 Minute: This value is the lowest of the occupational exposure Ceiling Limits identified by ACGIH, NIOSH, or OSHA. Note: Ceiling Limits are maximum values, but are often defined for specific time periods, i.e., 10, 15 or 20 min. The original source should be consulted for more detailed information.

15 Minute: This value is the lowest of the occupational exposure Short-term Exposure Limits (STELs) identified by ACGIH, NIOSH, or OSHA. A STEL is typically defined by a 15 minute exposure time.

8 Hour: This value is the lowest of the occupational time-weighted average exposure limits identified by ACGIH or OSHA.

10 Hour: This value is the time-weighted average exposure limits for a 10-hr work day recommended by NIOSH.

24 Hour: This value is the Ambient Air Quality Standard established by EPA.

RCRA: This value is the RCRA Action Level.

Noncancer Control Limit: This value is the RfC derived by EPA or the equivalent RfC estimated from the RfD.

Unit Risk: This value is the excess cancer risk associated with lifetime exposure to 1 $\mu g/m^3$ of the contaminant.

Cancer Control Limit: This value is the atmospheric concentration associated with a cancer risk of 10^{-6} if the contaminant is in EPA Cancer Classification A or B, or with a risk of 10^{-5} if the contaminant is in class C.

EPA Cancer Classification: This is the classification used to derive the Cancer Control Limit.

Absorption Factor: This is the gastrointestinal absorption factor used to derive an RfC from an oral RfD. Pulmonary absorption is assumed to be 100%.

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk ($\mu g/m^3)^{-1}$	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
ANTU	NA	NA	3.00E+02	3.00E+02	NA	NA	NA	NA	NA		
Acetaldehyde	4.50E+04	NA	3.60E+05	NA	NA	NA	7.20E+00	2.20E-06	4.00E-01	B2	80[53]
Acetamide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Acetone Cyanohydrin	4.00E+03	NA	NA	NA	NA	NA	5.00E+00	NA	NA		50[53]
Acetone Thiosemicarbazide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Acetonitrile	NA	NA	6.70E+04	3.40E+04	NA	NA	2.50E+01	NA	NA		50[53]
Acetophenone	NA	NA	4.90E+04	NA	NA	2.00E-01	1.00E-02	NA	NA	D	50[53]
Acetylaminofluorene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Acetylene	2.66E+06	NA	NA	NA	NA	NA	NA	NA	NA		
Acrolein	NA	6.88E+02	2.30E+02	2.50E+02	NA	NA	1.00E-02	NA	NA	C	50[53]
Acrylamide	NA	NA	3.00E+01	3.00E+02	NA	8.00E-04	3.47E-01	1.30E-03	4.00E-04	B2	50[53]
Acrylic Acid	NA	NA	5.90E+03	6.00E+03	NA	NA	5.00E-01	NA	NA		50[53]
Acrylonitrile	2.17E+04	NA	4.30E+03	2.17E+03	NA	1.00E-02	1.00E+00	6.80E-05	5.00E-02		50[53]
Acrylyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Adiponitrile	NA	NA	8.80E+03	1.80E+04	NA	NA	NA	NA	NA		
Aldicarb	NA	NA	NA	NA	NA	NA	1.73E+00	NA	NA	D	50[53]
Aldrin	NA	NA	2.50E+02	2.50E+02	NA	2.00E-04	5.20E-02	4.90E-03	1.00E-04	B2	50[53]
Allyl Alcohol	NA	1.00E+04	4.80E+03	5.00E+03	NA	NA	8.66E+00	NA	NA		50[53]
Allyl Chloride	NA	6.00E+03	3.00E+03	3.00E+03	NA	NA	5.00E-01	NA	NA	C	50[53]
Allylamine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Aluminum	NA	NA	1.00E+04	1.00E+04	NA	NA	NA	NA	NA		
Aluminum (alkyls)	NA	NA	2.00E+03	2.00E+03	NA	NA	NA	NA	NA		
Aluminum (metal dust, respirable fraction)	NA	NA	5.00E+03	5.00E+03	NA	NA	NA	NA	NA		
Aluminum (pyro powders)	NA	NA	5.00E+03	5.00E+03	NA	NA	NA	NA	NA		
Aluminum (soluble salts)	NA	NA	2.00E+03	2.00E+03	NA	NA	NA	NA	NA		
Aluminum (welding fume)	NA	NA	5.00E+03	5.00E+03	NA	NA	NA	NA	NA		
Aluminum Phosphide	NA	NA	NA	NA	NA	NA	2.77E-02	NA	NA		20[53]
Aminobiphenyl, 4-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Aminopterin	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Amiton	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Amiton Oxalate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ammonia	NA	2.70E+04	1.70E+04	1.80E+04	NA	NA	2.00E+01	NA	NA		20[53]
Ammonium Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ammonium Picrate	NA	NA	NA	NA	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Date Printed - 04/10/95

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk ($\mu g/m^3$)-1	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Amphetamine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Aniline	NA	NA	7.60E+03	NA	NA	NA	5.00E-01	NA	3.07E-01	B2	50[53]
Aniline, 2,4,6-Trimethyl-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Anisidine, o-	NA	NA	5.00E+02	5.00E+02	NA	NA	NA	NA	NA		
Anthracene	NA	NA	NA	1.00E+02	NA	NA	7.90E+02	NA	NA	D	76[4]
Antimony	NA	NA	5.00E+02	5.00E+02	NA	NA	2.77E-02	NA	NA		2[5]
Antimony Compounds (as Sb)	NA	NA	5.00E+02	5.00E+02	NA	NA	5.54E-04	NA	NA		2[5]
Antimony Pentafluoride	NA	NA	5.00E+02	NA	NA	NA	NA	NA	NA		
Antimycin A	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Arsenic	2.00E+00	NA	1.00E+01	NA	NA	7.00E-05	4.28E-01	4.30E-03	8.20E-05	A	41[6]
Arsenic (Inorganic compounds)	2.00E+00	NA	1.00E+01	NA	NA	NA	1.75E-01	4.30E-03	8.20E-05	A	41[6]
Arsenic (Organic compounds)	NA	NA	5.00E+02	NA	NA	NA	NA	NA	NA		
Arsenic Pentoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Arsenous Oxide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Arsenous Trichloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Arsine	2.00E+00	NA	1.60E+02	NA	NA	NA	1.00E-02	NA	NA		20[53]
Azinphos-Ethyl	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Azinphos-Methyl	NA	NA	2.00E+02	2.00E+02	NA	NA	NA	NA	NA		
Barium	NA	NA	5.00E+02	NA	NA	4.00E-01	3.50E-02	NA	NA		7[7]
Barium (Soluble compounds)	NA	NA	5.00E+02	5.00E+02	NA	NA	NA	NA	NA		
Barium Nitrate	NA	NA	NA	5.00E+02	NA	NA	NA	NA	NA		
Benzal Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Benzenamine, 3-(Trifluoromethyl)	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Benzene	NA	3.19E+03	3.19E+03	3.19E+02	NA	NA	NA	8.30E-06	9.70E-02	A	97[8]
Benzene, 1-(Chloromethyl)-4-nitro-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Benzenearsonic Acid	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Benzidine	NA	NA	NA	NA	NA	2.00E-05	8.32E+00	6.70E-02	1.60E-05	A	80[53]
Benzimidazole, 4,5-Dichloro-2-(trifluoromethyl)	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Benzo(a)anthracene	NA	NA	2.00E+02	1.00E+02	NA	NA	NA	NA	NA	B2	
Benzo(a)pyrene (also see Coal Tar Pitch Volatiles)	NA	NA	2.00E+02	1.00E+02	NA	NA	NA	NA	1.49E-04	B2	31[1]
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	B2	
Benzo(c)acridine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	B2	
Benzotrichloride	NA	NA	NA	NA	NA	NA	NA	NA	1.35E-04	B2	50[53]

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Date Printed - 04/10/95

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk ($\mu g/m^3$)$^{-1}$	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Benzyl Alcohol	NA	NA	NA	NA	NA	NA	5.20E+02	NA	NA		50[53]
Benzyl Chloride	5.00E+03	NA	5.00E+03	NA	NA	NA	NA	NA	1.03E-02	B2	50[53]
Benzyl Cyanide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Beryllium	5.00E+00	NA	2.00E+00	5.00E-01	NA	4.00E-04	1.73E-01	2.40E-03	4.00E-06	B2	1[10, 11]
Beryllium Compounds (as Be)	5.00E+00	NA	2.00E+00	5.00E-01	NA	4.00E-04	3.47E-02	2.40E-03	8.00E-06	B2	20[53]
Bicyclo [2.2.1] Heptane-2-carbonitrile, 5-chlor-6-(((methylamino)carbonyl) oxy)imino)-(1	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Biphenyl (diphenyl)	NA	NA	1.00E+03	1.00E+03	NA	NA	8.66E+01	NA	NA	D	50[53]
Bitoscanate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Boric Acid	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Boron	NA	NA	NA	NA	NA	NA	4.00E+00	NA	NA		20[53]
Boron Trichloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Boron Trifluoride	2.80E+03	NA	3.00E+03	NA	NA	NA	2.80E-02	NA	NA		20[53]
Boron Trifluoride Compound with Methyl Ether (1:1)	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Bromadiolone	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Bromine	NA	2.00E+03	6.60E+02	7.00E+02	NA	NA	NA	NA	NA		
Bromoform	NA	NA	5.00E+03	5.00E+03	NA	NA	5.54E+01	1.10E-06	7.20E-01	B2	80[53]
Butadiene, 1,3-	NA	NA	4.40E+03	NA	NA	NA	NA	2.80E-04	3.20E-03	B2	80[53]
Butene, i-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Butene, n-	NA	NA	1.90E+06	1.90E+06	NA	NA	NA	NA	NA		
Butene, 1-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Butene, cis-2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Butene, i-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Butene, trans-2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Butyl benzyl phthalate	NA	NA	NA	NA	NA	NA	4.23E+02	NA	NA	C	61[46]
Butylbenzene, sec-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Butylphenol, 2,2-Methylene bis(4-methyl) 6-t-butylphen-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Cadmium	NA	NA	5.00E+00	NA	NA	6.00E-04	1.73E-02	1.80E-03	6.00E-06	B1	1[13,14,15,1]
Cadmium (dust)	6.00E+02	NA	2.00E+00	NA	NA	NA	NA	NA	NA	B1	
Cadmium (dusts and salts)	NA	NA	5.00E+00	NA	NA	NA	NA	NA	NA		
Cadmium (fume)	3.00E+02	NA	5.00E+00	NA	NA	NA	NA	NA	NA	B1	
Cadmium Compounds (as Cd)	NA	NA	5.00E+00	NA	NA	6.00E-04	3.47E-04	1.80E-03	1.20E-05	B1	2[13,14,15,1]
Cadmium Oxide	NA	NA	5.00E+00	NA	NA	NA	NA	NA	NA		
Cadmium Stearate	NA	NA	5.00E+00	NA	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Date Printed - 04/10/95

Chemical:	1 Minute (µg/m³)	15 Minute (µg/m³)	8 Hour (µg/m³)	10 Hour (µg/m³)	24 Hour (µg/m³)	RCRA (µg/m³)	Noncancer Control Limit (µg/m³)	Unit Risk (µg/m³)-1	Cancer Control Limit (µg/m³)	EPA Cancer Classification	Absorption Factor (%)
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Calcium Arsenate	2.00E+00	NA	NA	NA	NA	NA	NA	NA	NA		
Calcium Cyanamide	NA	NA	5.00E+02	NA	NA	NA	NA	NA	NA		
Calcium Stearate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Camphechlor	NA	NA	NA	NA	NA	NA	NA	3.20E-04	1.50E-03	B2	50[53]
Cantharidin	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Caprolactam (dust)	NA	3.00E+03	1.00E+03	1.00E+03	NA	NA	8.66E+02	NA	NA		50[53]
Captan	NA	NA	5.00E+03	5.00E+03	NA	NA	2.25E+02	NA	5.00E-01	B2	50[53]
Carbachol Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Carbamic Acid, Methyl, 0-(((2,4-dimethyl-1, 3-dithiolan-2-yl) methylene)amino)-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Carbaryl	NA	NA	5.00E+03	5.00E+03	NA	NA	1.73E+02	NA	NA		50[53]
Carbofuran	NA	NA	1.00E+02	1.00E+02	NA	NA	8.66E+00	NA	NA		50[53]
Carbon Disulfide	9.30E+04	3.00E+04	3.10E+04	3.00E+03	NA	NA	8.00E+00	NA	NA		80[53]
Carbon Monoxide	2.29E+05	NA	2.90E+04	4.00E+04	1.03E+01	NA	NA	NA	NA		
Carbon Tetrachloride	1.57E+05	1.26E+04	3.10E+04	NA	NA	3.00E-02	1.58E+00	1.50E-05	4.55E-02	B2	65[17]
Carbonyl Sulfide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Carbophenothion	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Carene, delta-3-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Catechol	NA	NA	2.30E+04	2.00E+04	NA	NA	NA	NA	NA		
Chloracetic Acid	NA	NA	NA	NA	NA	NA	3.47E+00	NA	NA		50[53]
Chloramben	NA	NA	NA	NA	NA	NA	2.60E+01	NA	NA		50[53]
Chlordane	NA	NA	5.00E+02	5.00E+02	NA	3.00E-03	1.04E-01	3.70E-04	1.50E-03	B2	50[53]
Chlorfenvinfos	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Chlorine	1.45E+03	NA	1.50E+03	NA	NA	NA	6.93E+01	NA	NA		20[53]
Chlormephos	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Chlormequat Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Chloroacetophenone, 2-	NA	NA	3.00E+02	3.00E+02	NA	NA	1.50E-02	NA	NA		50[53]
Chlorobenzene	NA	NA	4.60E+04	NA	NA	2.00E+01	6.20E+00	NA	NA	D	31[18]
Chlorobenzilate	NA	NA	NA	NA	NA	NA	3.47E+01	7.80E-06	6.48E-03	B2	50[53]
Chloroethanol	3.00E+03	NA	1.60E+04	NA	NA	NA	NA	NA	NA		
Chloroethyl Chloroformate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Chloroform	2.40E+05	9.78E+03	4.90E+04	NA	NA	4.00E-02	6.93E+00	2.30E-05	8.00E-03	B2	20[18]
Chloromethyl Ether	NA	NA	4.70E+00	NA	NA	NA	NA	6.20E-02	1.28E-05	A	80[53]
Chloromethyl Methyl Ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	A	

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Date Printed - 04/10/95

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk ($\mu g/m^3$)-1	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Chlorophacinone	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Chloroprene	3.60E+03	NA	3.60E+04	NA	NA	NA	3.50E+00	NA	NA		50[53]
Chloropropane, 1,2-dibromo-3-	NA	NA	9.67E+00	NA	NA	NA	1.60E-01	6.90E-07	1.17E+00	B2	80[53]
Chlorothiophos	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Chloroxuron	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Chromic Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Chromium	NA	NA	5.00E+02	5.00E+02	NA	NA	NA	NA	NA		
Chromium Compounds (As Cr) (does not include Cr VI cmpds)	NA	NA	5.00E+02	5.00E+02	NA	NA	NA	NA	NA		
Chrysene	NA	NA	2.00E+02	1.00E+02	NA	NA	NA	NA	NA	B2	
Coal Tar Pitch Volatiles (as benzene solubles)	NA	NA	2.00E+02	1.00E+02	NA	NA	NA	NA	NA		
Cobalt Carbonyl	NA	NA	1.00E+02	1.00E+02	NA	NA	NA	NA	NA		
Cobalt Compounds	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Cobalt, ((2,2-(1,2-Ethanediylbis (nitrilo-methylidyne))Bis (6-fluorophenolato))(2-)-NNOO)	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Coke Oven Emissions	NA	NA	1.50E+02	5.00E+02	NA	NA	NA	NA	NA		
Colchicine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Copper	NA	NA	1.00E+03	1.00E+03	NA	NA	NA	NA	NA	D	
Copper (dusts and mists)	NA	NA	1.00E+03	1.00E+03	NA	NA	NA	NA	NA	D	
Copper (fume)	NA	NA	1.00E+02	1.00E+02	NA	NA	NA	NA	NA	D	
Coumaphos	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Coumatetralyl	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Cresols/Cresylic Acid (isomers and mixture) (cresol)	NA	NA	2.20E+04	1.00E+04	NA	NA	NA	NA	NA		
Cresols/Cresylic Acid (isomers and mixture) (m-cresol)	NA	NA	2.20E+04	1.00E+04	NA	NA	8.66E+01	NA	NA	C	50[53]
Cresols/Cresylic Acid (isomers and mixture) (o-cresol)	NA	NA	2.20E+04	1.00E+04	NA	NA	8.66E+01	NA	NA	C	50[53]
Cresols/Cresylic Acid (isomers and mixture) (p-cresol)	NA	NA	2.20E+04	1.00E+04	NA	NA	8.66E+00	NA	NA	C	50[53]
Crimidine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Crotonaldehyde	NA	NA	5.70E+03	6.00E+03	NA	NA	NA	NA	NA		
Crotonaldehyde, (E)-	NA	NA	6.00E+03	6.00E+03	NA	NA	NA	NA	4.61E-03	C	50[53]
Cumene (Isopropylbenzene)	NA	NA	2.45E+05	2.45E+05	NA	NA	4.50E+00	NA	NA		50[53]
Cyanide Compounds (as free cyanide)	5.00E+03	5.00E+03	5.00E+03	NA	NA	NA	3.47E+01	NA	NA		50[53]
Cyanogen Bromide	NA	NA	NA	NA	NA	NA	1.56E+02	NA	NA		50[53]
Cyanogen Iodide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Cyanophos	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Cyanuric Fluoride	NA	NA	NA	NA	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Date Printed - 04/10/95

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk ($\mu g/m^3$)$^{-1}$	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Cycloheximide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Cyclohexylamine	NA	NA	4.10E+04	4.00E+04	NA	NA	3.47E+02	NA	NA		50[53]
Cyclopentane	NA	NA	1.72E+06	1.72E+06	NA	NA	NA	NA	NA		
Cyclopentene	NA	NA	NA	NA	NA	NA	NA	NA	NA		
DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA		
DEHP (Bis(2-ethylhexyl)phthalate)	NA	1.00E+04	5.00E+03	5.00E+03	NA	NA	1.32E+01	NA	4.75E-02	B2	19[12]
Decaborane (14)	NA	9.00E+02	2.50E+02	3.00E+02	NA	NA	NA	NA	NA		
Demeton	NA	NA	1.00E+02	1.00E+02	NA	NA	6.93E-02	NA	NA		50[53]
Demeton-S-Methyl	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dialifor	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Diazomethane	NA	NA	3.40E+02	4.00E+02	NA	NA	NA	NA	NA		
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	B2	
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Diborane	NA	NA	1.00E+02	1.00E+02	NA	NA	NA	NA	NA		
Dibutylphthalate	NA	NA	5.00E+03	5.00E+03	NA	NA	3.47E+02	NA	NA	D	100[22]
Dichlorobenzene, 1,4- (p)	NA	NA	6.00E+04	NA	NA	NA	7.20E+02	NA	1.31E-01	B2	90[50]
Dichlorobenzidine, 3,3'-	NA	NA	NA	NA	NA	NA	NA	NA	3.89E-03	B2	50[53]
Dichlorobutene, Trans-1,4-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dichloroethyl Ether (Bis(2-chloroethyl)ether)	9.00E+04	6.00E+04	2.90E+04	3.00E+04	NA	3.00E-03	NA	3.30E-04	1.50E-03	B2	50[53]
Dichloromethylphenylsilane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dichlorophenoxyacetic Acid, 2,4- (2,4-D) salts and esters	NA	NA	1.00E+04	1.00E+04	NA	NA	1.73E+01	NA	NA		50[53]
Dichloropropene, 1,3-	NA	NA	4.50E+03	5.00E+03	NA	NA	1.60E+01	3.70E-06	2.16E-02	B2	80[63]
Dichlorvos (DDVP)	NA	NA	9.00E+02	1.00E+03	NA	NA	2.50E-01	NA	6.03E-03	B2	50[53]
Dicrotophos (Bidrin)	NA	NA	2.50E+02	2.50E+02	NA	NA	1.73E-01	NA	NA		50[53]
Diepoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Diepoxybutane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Diethanolamine	NA	NA	2.00E+03	1.50E+04	NA	NA	NA	NA	NA		
Diethyl Chlorophospate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Diethyl Phthalate	NA	NA	5.00E+03	5.00E+03	NA	NA	2.49E+03	NA	NA	D	90[47]
Diethyl Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Diethylcarbamazine Citrate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Diethylenetriamine	NA	NA	4.20E+03	4.00E+03	NA	NA	NA	NA	NA		
Diethylhexylsebacate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Digitoxin	NA	NA	NA	NA	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk ($\mu g/m^3$)-1	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Diglycidyl Ether	2.80E+03	NA	5.30E+02	5.00E+02	NA	NA	NA	NA	NA		
Digoxin	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Diisopropylmethylphosphonate	NA	NA	NA	NA	NA	NA	2.22E+02	NA	NA	D	80[52]
Dimefox	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dimethoate	NA	NA	NA	NA	NA	NA	3.47E-01	NA	NA		50[53]
Dimethoxybenzidine, 3,3'-	NA	NA	NA	NA	NA	NA	NA	NA	1.25E-01	B2	50[53]
Dimethyl Aminoazobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dimethyl Carbamoyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dimethyl Formamide	NA	NA	3.00E+04	3.00E+04	NA	NA	2.40E+01	NA	NA		80[53]
Dimethyl Phosphorochloridothioate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dimethyl Phthalate	NA	NA	5.00E+03	5.00E+03	NA	NA	NA	NA	NA	D	
Dimethyl Sulfate	NA	NA	5.20E+02	5.00E+02	NA	NA	NA	NA	NA	B2	
Dimethyl-p-Phenylenediamine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dimethylaniline (N,N-Dimethylaniline)	NA	5.00E+04	2.50E+04	2.50E+04	NA	NA	3.47E+00	NA	NA		50[53]
Dimethylbenzidine, 3,3'-	2.00E+01	NA	NA	NA	NA	NA	NA	NA	1.90E-04	B2	50[53]
Dimethylbutane, 2,2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dimethylbutane, 2,3-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dimethyldichlorosilane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dimethylhexane, 2,3-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dimethylhexane, 2,4-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dimethylhydrazine	1.50E+02	NA	1.00E+03	NA	NA	NA	NA	NA	NA		
Dimethylpentane, 2,4-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dimethylphenethylamine, alpha, alpha-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dimetilan	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dinitro-o-cresol, 4,6- and salts	NA	NA	2.00E+02	2.00E+02	NA	NA	NA	NA	NA		
Dinitrobenzene, 1,3-	NA	NA	1.00E+03	1.00E+03	NA	NA	1.73E-01	NA	NA	D	50[53]
Dinitrobenzenes (all isomers)	NA	NA	1.00E+03	1.00E+03	NA	NA	NA	NA	NA		
Dinitrocresol	NA	NA	2.00E+02	2.00E+02	NA	NA	NA	NA	NA		
Dinitrophenol, 2,4-	NA	NA	NA	NA	NA	NA	3.47E+00	NA	NA		50[53]
Dinitropyrene, 1,6-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dinitrotoluene	NA	NA	1.50E+02	1.50E+03	NA	NA	NA	NA	NA		
Dinitrotoluene, 2,4-	NA	NA	1.50E+02	1.50E+03	NA	NA	2.08E+00	NA	NA		60[52]
Dinitrotoluene, 2,6-	NA	NA	1.50E+02	1.50E+03	NA	NA	1.47E+00	NA	NA		85[26]
Dinitrotoluene, Mixture	NA	NA	NA	NA	NA	NA	NA	NA	1.54E-03	B2	60[52]

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Date Printed - 04/10/95

Chemical:	1 Minute (µg/m³)	15 Minute (µg/m³)	8 Hour (µg/m³)	10 Hour (µg/m³)	24 Hour (µg/m³)	RCRA (µg/m³)	Noncancer Control Limit (µg/m³)	Unit Risk (µg/m³)-1	Cancer Control Limit (µg/m³)	EPA Cancer Classification	Absorption Factor (%)
Dinoseb	NA	NA	NA	NA	NA	NA	1.73E+00	NA	NA	D	50[53]
Dinoterb	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dioctyl Sebacate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dioxane, 1,4- (1,4-Diethyleneoxide)	3.60E+03	NA	9.00E+04	NA	NA	NA	NA	NA	1.59E-01	B2	50[53]
Dioxathion	NA	NA	2.00E+02	2.00E+02	NA	NA	NA	NA	NA		
Diphacinone	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Diphenylamine	NA	NA	1.00E+04	1.00E+04	NA	NA	4.33E+01	NA	NA	D	50[53]
Diphenylhydrazine, 1,2-	NA	NA	NA	NA	NA	4.00E-03	NA	2.20E-04	2.50E-03	B2	50[53]
Diphenyloxazole, 2,5-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Diphosphoramide, Octamethyl-	NA	NA	NA	NA	NA	NA	3.47E+00	NA	NA		50[53]
Disulfoton	NA	NA	1.00E+02	1.00E+02	NA	NA	6.93E-02	NA	NA		50[53]
Dithiazanine Iodide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Dithiobiuret	NA	NA	NA	NA	NA	NA	NA	NA	NA		
EPN	NA	NA	1.00E+02	5.00E+02	NA	NA	1.73E-02	NA	NA		50[53]
Emetine, Dihydrochloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Endosulfan	NA	NA	1.00E+02	1.00E+02	NA	NA	1.04E+01	NA	NA		50[53]
Endothion	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Endrin	NA	NA	1.00E+02	1.00E+02	NA	NA	5.20E-01	NA	NA	D	50[53]
Epichlorohydrin	NA	NA	7.60E+03	NA	NA	8.00E-01	5.00E-01	1.20E-06	4.00E-01	B2	50[53]
Epoxybutane, 1,2-	NA	NA	NA	NA	NA	NA	1.60E+01	NA	NA		80[53]
Ergocalciferol	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ergotamine Tartrate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ethane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ethanesulfonyl Chloride, 2-Chloro	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ethanol, 1,2-Dichloro-, Acetate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ethion	NA	NA	4.00E+02	4.00E+02	NA	NA	8.66E-01	NA	NA		50[53]
Ethoprophos	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ethybis(2-Chloroethyl)amine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ethyl Acrylate	NA	NA	2.00E+04	NA	NA	NA	NA	NA	3.65E-02	B2	50[53]
Ethyl Benzene	NA	5.45E+05	4.34E+05	4.35E+05	NA	NA	9.70E+02	NA	NA	D	97[8]
Ethyl Carbamate (Urethane)	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ethyl Chloride (Chloroethane)	NA	NA	2.60E+06	NA	NA	NA	8.00E+03	NA	NA		80[53]
Ethylcyclohexane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ethylene	NA	NA	NA	NA	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Chemical:	1 Minute (µg/m³)	15 Minute (µg/m³)	8 Hour (µg/m³)	10 Hour (µg/m³)	24 Hour (µg/m³)	RCRA (µg/m³)	Noncancer Control Limit (µg/m³)	Unit Risk (µg/m³)-1	Cancer Control Limit (µg/m³)	EPA Cancer Classification	Absorption Factor (%)
Ethylene Dibromide (Dibromoethane)	9.99E+02	NA	1.54E+05	3.46E+02	NA	5.00E-03	1.28E-01	2.20E-04	4.00E-03	B2	80[53]
Ethylene Dichloride (1,2-Dichloroethane)	4.05E+05	8.00E+03	4.00E+04	4.00E+03	NA	4.00E-02	NA	2.60E-05	4.00E-02	B2	100[23]
Ethylene Fluorohydrin	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ethylene Glycol	1.27E+05	NA	NA	NA	NA	NA	2.77E+03	NA	NA	D	50[53]
Ethylene Oxide	9.00E+03	NA	1.80E+03	1.80E+02	NA	NA	NA	1.00E-04	6.40E-03	B1	80[53]
Ethylene Thiourea	NA	NA	NA	NA	NA	NA	1.11E-01	NA	1.27E-02	B1	50[53]
Ethylenediamine	NA	NA	2.50E+04	2.50E+04	NA	NA	2.77E+01	NA	NA	D	50[53]
Ethyleneimine	NA	NA	8.80E+02	NA	NA	NA	NA	NA	NA		
Ethylhexane, 3-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ethylidene Dichloride (1,1-Dichloroethane)	NA	NA	4.00E+05	4.00E+05	NA	NA	5.00E+02	NA	NA	C	100[48]
Ethylthiocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ethyltoluene, 1-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ethyltoluene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ethyltoluene, 3-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Fenamiphos	NA	NA	1.00E+02	1.00E+02	NA	NA	4.33E-01	NA	NA	D	50[53]
Fenitrothion	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Fensulfothion	NA	NA	1.00E+02	1.00E+02	NA	NA	NA	NA	NA		
Fluenetil	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Fluoranthene	NA	NA	NA	NA	NA	NA	4.30E+01	NA	NA	D	31[1]
Fluorene	NA	NA	NA	NA	NA	NA	6.93E+01	NA	NA	D	50[53]
Fluorine	NA	NA	2.00E+02	2.00E+02	NA	NA	2.02E+02	NA	NA		97[26]
Fluoroacetamide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Fluoroacetic Acid	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Fluoroacetyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Fluorouracil	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Fonofos	NA	NA	1.00E+02	1.00E+02	NA	NA	3.47E+00	NA	NA	D	50[53]
Formaldehyde	1.23E+02	2.46E+03	9.21E+02	1.97E+01	NA	8.00E-02	3.47E+02	1.30E-05	4.00E-02	B1	50[53]
Formaldehyde Cyanohydrin	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Formetanate Hydrochloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Formothion	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Formparanate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Fosthietan	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Fuberidazole	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Furan	NA	NA	NA	NA	NA	NA	1.73E+00	NA	NA		50[53]

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Date Printed - 04/10/95

Chemical:	1 Minute (µg/m^3)	15 Minute (µg/m^3)	8 Hour (µg/m^3)	10 Hour (µg/m^3)	24 Hour (µg/m^3)	RCRA (µg/m^3)	Noncancer Control Limit (µg/m^3)	Unit Risk (µg/m^3)-1	Cancer Control Limit (µg/m^3)	EPA Cancer Classification	Absorption Factor (%)
Gallium	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Gallium Trichloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Germanium	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Glycol Ethers	NA	NA	NA	NA	NA	NA	NA	NA	NA		
HMX (Cyclotetramethylene Tetranitramine)	NA	NA	NA	NA	NA	NA	8.66E+00	NA	NA	D	6[52]
Heptachlor	NA	NA	5.00E+02	5.00E+02	NA	8.00E-04	8.66E-01	1.30E-03	4.00E-04	B2	50[53]
Heptane, n-	1.80E+06	NA	1.64E+06	3.50E+05	NA	NA	NA	NA	NA	D	
Hexachlorobenzene	NA	NA	NA	NA	NA	NA	1.39E+00	4.60E-04	1.00E-03	B2	50[53]
Hexachlorobutadiene	NA	NA	2.10E+02	2.40E+02	NA	4.00E-01	NA	2.20E-05	2.50E-01	C	50[53]
Hexachlorocyclopentadiene	NA	NA	1.10E+02	1.00E+02	NA	7.00E-02	3.50E-02	NA	NA	D	50[53]
Hexachloroethane	NA	NA	9.70E+03	1.00E+04	NA	3.00E-00	3.12E+00	4.00E-06	2.70E+00	C	90[52]
Hexamethylene-1,6-diisocyanate	1.38E+02	NA	3.40E+01	3.44E+01	NA	NA	5.00E-03	NA	NA		50[53]
Hexamethylenediamine, N,N-dibutyl-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Hexamethylphosphoramide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Hexane, n-	NA	NA	1.76E+05	1.80E+05	NA	NA	1.60E+02	NA	NA	D	80[53]
Hexene, 1-	NA	NA	1.76E+06	NA	NA	NA	NA	NA	NA		
Hexene, cis-2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Hexene, trans-2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Hydrazine	4.00E+01	NA	1.30E+02	NA	NA	2.00E-04	NA	4.90E-03	1.00E-04	B2	50[53]
Hydrochloric Acid or (Hydrogen chloride)	7.00E+03	NA	NA	NA	NA	NA	1.40E+00	NA	NA		20[53]
Hydrocyanic Acid or (Hydrogen cyanide)	5.00E+03	5.00E+03	1.10E+04	NA	NA	NA	1.50E+00	NA	NA		50[53]
Hydrogen Chloride, Anhydrous	7.00E+03	NA	NA	NA	NA	NA	1.40E+00	NA	NA		20[53]
Hydrogen Fluoride (Hydrofluoric acid)	2.60E+03	NA	2.46E+03	2.50E+03	NA	NA	NA	NA	NA		
Hydrogen Peroxide (saturated)	NA	NA	1.40E+03	1.40E+03	NA	NA	NA	NA	NA		
Hydrogen Selenide	NA	NA	1.60E+02	2.00E+02	NA	NA	NA	NA	NA		
Hydrogen Sulfide	1.50E+04	NA	1.40E+04	NA	NA	NA	1.80E-01	NA	NA		20[53]
Hydroquinone	2.00E+03	NA	2.00E+03	NA	NA	NA	6.93E+01	NA	NA		50[53]
Iodine	1.00E+03	NA	1.00E+03	NA	NA	NA	NA	NA	NA		
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Iron (soluble salts)	NA	NA	1.00E+03	1.00E+03	NA	NA	NA	NA	NA		
Iron, Pentacarbonyl-	NA	NA	2.30E+02	NA	NA	NA	NA	NA	NA		
Isobenzen	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Isobutyronitrile	NA	NA	NA	2.20E+04	NA	NA	NA	NA	NA		
Isocyanic Acid, 3,4-Dichlorophenyl Ester	NA	NA	NA	NA	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk $(\mu g/m^3)^{-1}$	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Isodrin	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Isofluorphate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Isophorone	2.80E+04	NA	1.40E+05	2.30E+04	NA	NA	3.47E+02	NA	1.84E+01	C	50[53]
Isophorone Diisocyanate	NA	1.80E+02	4.50E+01	4.50E+01	NA	NA	NA	NA	NA		
Isoprene	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Isopropyl Chloroformate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Isopropymethylpyrazolyl Dimethylcarbamate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ketone, Bis(Chloromethyl)	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Lactonitrile	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Lead (Inorganic dusts and fume)	NA	NA	5.00E+01	1.00E+02	NA	NA	NA	NA	NA		
Lead (inorganic)	NA	NA	5.00E+01	1.00E+02	1.50E+00	NA	NA	NA	NA	B2	
Lead (metal)	NA	NA	5.00E+01	1.00E+02	NA	NA	NA	NA	NA	B2	
Lead Azide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Lead Compounds (as Pb)	NA	NA	5.00E+01	1.00E+02	NA	NA	NA	NA	NA		
Lead Styphnate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Lead, Tetraethyl	NA	NA	7.50E+01	7.50E+01	NA	NA	NA	NA	NA		
Lead, Tetramethyl	NA	NA	7.50E+01	7.50E+01	NA	NA	NA	NA	NA		
Leptophos	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Lewisite	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Limonene, delta-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Lindane	NA	NA	5.00E+02	5.00E+02	NA	NA	5.20E-01	NA	1.35E-03	B2	50[53]
Lithium Hydride	NA	NA	2.50E+01	2.50E+01	NA	NA	NA	NA	NA		
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Magnesium Oxide (fume)	NA	NA	1.00E+04	NA	NA	NA	NA	NA	NA		
Maleic Anhydride	NA	NA	1.00E+03	1.00E+03	NA	NA	1.73E+02	NA	NA		50[53]
Malononitrile	NA	NA	NA	8.00E+03	NA	NA	3.47E-02	NA	NA		50[53]
Manganese	5.00E+03	3.00E+03	NA	1.00E+03	NA	NA	2.00E-03	NA	NA	D	4[27]
Manganese (Dust and compounds)	5.00E+03	3.00E+03	5.00E+03	1.00E+03	NA	NA	NA	NA	NA		
Manganese (fume)	5.00E+03	3.00E+03	1.00E+03	1.00E+03	NA	NA	NA	NA	NA	D	
Manganese Compounds (as Mn)	5.00E+03	3.00E+03	5.00E+03	1.00E+03	NA	NA	8.00E-05	NA	NA		4[27]
Manganese, Tricarbonyl Methylcyclopentadienyl	NA	NA	2.00E+02	NA	NA	NA	NA	NA	NA		
Mechlorethamine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Mephosfolan	NA	NA	NA	NA	NA	NA	1.56E-01	NA	NA		50[53]
Mercuric Acetate	NA	NA	NA	NA	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk ($\mu g/m^3$)-1	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Mercuric Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Mercuric Oxide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Mercury	1.00E+02	NA	2.50E+01	NA	NA	NA	NA	NA	NA	D	
Mercury (Alkyl compounds)	4.00E+01	3.00E+01	1.00E+01	1.00E+01	NA	NA	NA	NA	NA		
Mercury (Aryl & Inorganic compounds)	1.00E+02	NA	1.00E+02	NA	NA	NA	NA	NA	NA		
Mercury (Inorganic)	1.00E+02	NA	2.50E+01	1.00E+02	NA	NA	1.20E-02	NA	NA		20[20]
Mercury (vapor)	1.00E+02	NA	2.50E+01	5.00E+01	NA	NA	1.20E-02	NA	NA	D	20[20]
Mercury Fulminate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methacrolein Diacetate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methacrylic Anhydride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methacrylonitrile	NA	NA	2.70E+03	3.00E+03	NA	7.00E-01	3.50E-01	NA	NA		50[53]
Methacryloyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methacryloyloxyethyl Isocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methamidophos	NA	NA	NA	NA	NA	NA	8.66E-02	NA	NA		50[53]
Methane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methanesulfonyl Fluoride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methanol	NA	3.25E+05	2.60E+05	2.60E+05	NA	NA	1.39E+03	NA	NA		80[53]
Methidathion	NA	NA	NA	NA	NA	NA	1.73E+00	NA	NA	C	50[53]
Methiocarb	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methicarb	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methomyl	NA	NA	2.50E+03	2.50E+03	NA	NA	4.33E+01	NA	NA		50[53]
Methoxychlor	NA	NA	1.00E+04	NA	NA	NA	8.66E+00	NA	NA	D	50[53]
Methoxyethylmercuric Acetate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl 2-Chloroacrylate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl Bromide (Bromomethane)	8.00E+04	NA	1.90E+04	NA	NA	3.00E+01	4.00E+00	NA	NA	D	80[53]
Methyl Chloride (Chloromethane)	4.13E+05	NA	1.03E+05	NA	NA	NA	NA	1.80E-06	4.44E+00	C	80[53]
Methyl Chloroformate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl Ethyl Ketone (2-Butanone)	NA	3.00E+05	5.90E+05	5.90E+05	NA	3.00E+02	8.00E+02	NA	NA	D	80[53]
Methyl Hydrazine	8.00E+01	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl Iodide (Iodomethane)	NA	NA	1.20E+04	1.00E+04	NA	NA	NA	NA	NA		
Methyl Isobutyl Ketone (Hexone)	NA	3.00E+05	2.05E+05	2.05E+05	NA	7.00E+01	6.40E+01	NA	NA		80[53]
Methyl Isocyanate	NA	NA	4.70E+01	5.00E+01	NA	NA	NA	NA	NA		
Methyl Isothiocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl Mercaptan	1.00E+03	NA	9.80E+02	NA	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Date Printed - 04/10/95

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk ($\mu g/m^3$)-1	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Methyl Methacrylate	NA	NA	4.10E+05	4.10E+05	NA	NA	1.39E+02	NA	NA		50[53]
Methyl Phenkapton	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl Phosphonic Dichloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl Tert Butyl Ether	NA	NA	NA	NA	NA	NA	2.40E+03	NA	NA		80[53]
Methyl Thiocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl Vinyl Ketone	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl-1-Butene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl-1-Butene, 3-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl-1-Pentene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl-1-Pentene, 4-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl-2-Butene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyl-2-Pentene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methylcyclohexane	NA	NA	1.61E+06	1.60E+06	NA	NA	1.50E+03	NA	NA		50[53]
Methylcyclopentane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methylene Chloride (Dichloromethane)	3.47E+06	NA	1.74E+05	NA	NA	3.00E-01	2.85E+03	4.70E-07	1.90E+00	B2	95[28]
Methylene Diphenyl Diisocyanate (MDI)	2.00E+02	NA	5.10E+01	5.00E+01	NA	NA	1.00E-02	NA	NA		50[53]
Methylene bis(2-chloroaniline), 4,4'-	NA	NA	1.10E+02	3.00E+00	NA	NA	1.21E+00	3.70E-05	1.35E-02	B2	50[53]
Methylenedianiline, 4,4'-	NA	NA	8.10E+02	NA	NA	NA	NA	NA	NA		
Methylheptane, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methylhexane, 3-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methylhydantoin, 5-Ethyl-1,3-diglycidyl-5-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methylmercuric Dicyanamide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methylnaphthalene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methylpentane, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methylpentane, 3-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methyltrichlorosilane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Methytlnaphthalene, 1-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Mevinphos (Phosdrin)	NA	3.00E+02	9.20E+01	1.00E+02	NA	NA	NA	NA	NA		
Mexacarbate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Mineral fibers	NA	NA	NA	5.00E+03	NA	NA	NA	NA	NA		
Mitomycin C	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Molybdenum	NA	NA	1.50E+04	NA	NA	NA	6.58E+00	NA	NA		38[42]
Molybdenum (Insoluble compounds)	NA	NA	1.00E+04	NA	NA	NA	NA	NA	NA		
Molybdenum (Soluble compounds)	NA	NA	5.00E+03	NA	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Date Printed - 04/10/95

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk $(\mu g/m^3)^{-1}$	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Monocrotophos	NA	NA	2.50E+02	2.50E+02	NA	NA	NA	NA	NA		
Monoethylamine (Ethylamine)	NA	NA	9.20E+03	1.80E+04	NA	NA	NA	NA	NA		
Muscimol	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Mustard Gas	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Myrcene	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Naphthalene	NA	7.50E+04	5.00E+04	5.00E+04	NA	NA	1.11E+02	NA	NA	D	80[30]
Naphthaleneamine, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Naphthylamine, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nickel	NA	NA	1.00E+03	1.50E+01	NA	NA	1.87E+01	NA	NA		27[31]
Nickel (Metal)	NA	NA	1.00E+03	1.50E+01	NA	NA	NA	NA	NA		
Nickel (Refinery dust)	NA	NA	NA	NA	NA	NA	NA	2.40E-04	3.04E-04	A	27[31]
Nickel (Soluble compounds)	NA	NA	1.00E+02	NA	NA	NA	NA	NA	NA		
Nickel (Soluble salts)	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nickel Carbonyl	NA	NA	7.00E+00	7.00E+00	NA	NA	NA	NA	NA	B2	
Nicotine	NA	NA	5.00E+02	5.00E+02	NA	NA	NA	NA	NA		
Nicotine Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nitric Acid	NA	1.00E+04	5.00E+03	5.00E+03	NA	NA	NA	NA	NA		
Nitric Oxide	NA	NA	3.00E+04	3.00E+04	NA	NA	NA	NA	NA		
Nitrobenzene	NA	NA	5.00E+03	5.00E+03	NA	2.00E-00	1.94E+00	NA	NA	D	97[8]
Nitrobiphenyl, 4- (or 4-Nitrodiphenyl)	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nitrocellulose	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nitrocyclohexane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nitrodiphenylamine, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nitrodiphenylamine, 4-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nitrogen Dioxide	9.00E+03	NA	5.60E+03	1.80E+03	9.97E-02	NA	NA	NA	NA		
Nitroglycerine	2.00E+03	1.00E+02	4.60E+02	NA	NA	NA	NA	NA	NA		
Nitroguanidine	NA	NA	NA	NA	NA	NA	3.47E+02	NA	NA	D	100[52]
Nitromethane	NA	NA	5.00E+04	NA	NA	NA	NA	NA	NA		
Nitronaphthalene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nitrophenol, 4-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nitrophenol, o-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nitropropane, 2-	NA	NA	3.60E+04	NA	NA	NA	1.00E+01	2.70E+03	1.86E-04	B2	50[53]
Nitropyrene, 1-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nitroso-N-methylurea, N-	NA	NA	NA	NA	NA	NA	NA	NA	NA	B2	

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk ($\mu g/m^3$)-1	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Nitrosoethethylamine, N-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nitrosodimethylamine, N-	NA	NA	NA	NA	NA	7.00E-05	NA	1.40E-02	3.50E-05	B2	50[53]
Nitrosodiphenylamine, 4-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nitrosodiphenylamine, N-	NA	NA	NA	NA	NA	NA	NA	NA	3.57E-01	B2	50[53]
Nitrosomorpholine, N-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Nonane, n-	NA	NA	1.05E+06	1.05E+06	NA	NA	NA	NA	NA		
Norbormide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Octane, n-	1.80E+06	NA	1.40E+06	3.50E+05	NA	NA	NA	NA	NA		
Organorthodium Complex (PMN-92-147)	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ouabain	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Oxamyl	NA	NA	NA	NA	NA	NA	4.33E+01	NA	NA		50[53]
Oxetane, 3,3-Bis(chloromethyl)-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Oxydisulfoton	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Ozone	2.00E+02	NA	2.00E+02	2.00E+02	2.36E-01	NA	NA	NA	NA		
Paraquat	NA	NA	1.00E+02	NA	NA	NA	7.80E+00	NA	NA		50[53]
Paraquat Methosulfate	NA	NA	5.00E+02	NA	NA	NA	NA	NA	NA		
Parathion	NA	NA	1.00E+02	5.00E+01	NA	NA	1.73E+01	NA	NA	C	50[53]
Parathion, Methyl	NA	NA	2.00E+02	2.00E+02	NA	NA	2.17E-01	NA	NA		50[53]
Paris Green	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Particulates (PM10)	NA	NA	5.00E+03	NA	1.50E+02	NA	NA	NA	NA		
Particulates (PM10, total dust)	NA	NA	1.00E+04	NA	1.50E+02	NA	NA	NA	NA		
Pentaborane	NA	3.00E+01	1.00E+01	1.00E+01	NA	NA	NA	NA	NA		
Pentachloronitrobenzene (Quintobenzene)	NA	NA	5.00E+02	NA	NA	1.00E-01	5.20E+00	NA	6.73E-02	C	50[53]
Pentachlorophenol	NA	NA	5.00E+02	5.00E+02	NA	NA	1.04E+02	NA	2.92E-02	B2	100[45]
Pentadecylamine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Pentaerythritol Tetranitrate (PETN)	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Pentene	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Pentene, 1-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Pentene, cis-2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Pentene, trans-2-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Peracetic Acid	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Perchloromethylmercaptan	NA	NA	7.60E+02	8.00E+02	NA	NA	NA	NA	NA		
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	D	
Phenol	6.00E+04	NA	1.90E+04	1.90E+04	NA	NA	1.87E+03	NA	NA	D	90[9]

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Date Printed - 04/10/95

Chemical:	1 Minute (µg/m³)	15 Minute (µg/m³)	8 Hour (µg/m³)	10 Hour (µg/m³)	24 Hour (µg/m³)	RCRA (µg/m³)	Noncancer Control Limit (µg/m³)	Unit Risk (µg/m³)-1	Cancer Control Limit (µg/m³)	EPA Cancer Classification	Absorption Factor (%)
Phenol, 2,2 Thiobis(4-chloro-6-methyl)-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phenol, 3-(1 Methylethyl)-, Methylcarbamate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phenoxarsine, 10, 10-Oxydi-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phenyl Dichloroarsine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phenyldiisodecyl Phosphite	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phenylenediamine, p	NA	NA	1.00E+02	1.00E+02	NA	NA	3.29E+02	NA	NA		50[53]
Phenylhydrazine Hydrochloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phenylmercury Acetate	NA	NA	NA	NA	NA	NA	1.39E-01	NA	NA		50[53]
Phenylsilatrane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phenylthiourea	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phorate	NA	2.00E+02	5.00E+01	5.00E+01	NA	NA	3.47E-01	NA	NA		50[53]
Phosacetim	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phosfolan	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phosgene	8.00E+02	NA	4.00E+02	4.00E+02	NA	NA	NA	NA	NA		
Phosmet	NA	NA	NA	NA	NA	NA	3.47E+01	NA	NA		50[53]
Phosphamidon	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phosphine	NA	1.00E+03	4.00E+02	4.00E+02	NA	NA	6.00E-03	NA	NA	D	20[49]
Phosphonothioic Acid, Methyl-, O-(4-nitrophenyl) O-phenyl ester	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phosphonothioic Acid, Methyl-, O-ethyl O-(4-(methylthio)phenyl) ester	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phosphonothioic Acid, Methyl-, S-(2-(Bis(1-methylethyl)amino)ethyl O-ethyl ester	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phosphoric Acid, Dimethyl 4-(methylthio) phenyl ester	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phosphorothioic Acid, O,O-Dimethyl-S-(2-methylthio)ethyl ester	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phosphorus	NA	NA	1.00E+02	1.00E+02	NA	NA	4.16E-02	NA	NA	D	60[52]
Phosphorus (white, yellow)	NA	NA	1.00E+02	1.00E+02	NA	NA	2.49E-02	NA	NA	D	60[52]
Phosphorus Oxychloride	NA	3.00E+03	6.30E+02	6.00E+01	NA	NA	NA	NA	NA		
Phosphorus Pentachloride	NA	NA	8.50E+02	1.00E+03	NA	NA	NA	NA	NA		
Phosphorus Pentoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Phosphorus Trichloride	NA	NA	1.10E+03	1.50E+03	NA	NA	NA	NA	NA		
Phthalic Anhydride	NA	NA	6.10E+03	6.00E+03	NA	NA	6.00E+01	NA	NA		50[53]
Physostigmine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Physotigmine, Salicylate (1:1)	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Picric acid	NA	3.00E+02	1.00E+02	1.00E+02	NA	NA	NA	NA	NA		
Picrotoxin	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Pinene, alpha-	NA	NA	NA	NA	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk ($\mu g/m^3)^{-1}$	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Pinene, beta-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Piperidine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Pirimifos, Ethyl	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Polychlorinated Biphenyls (Aroclors)	NA	NA	NA	NA	NA	NA	NA	NA	2.27E-04	B2	50[53]
Polycylic Organic Matter	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Polystyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Potassium Arsenide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Potassium Cyanide	5.00E+03	NA	NA	NA	NA	NA	6.93E+00	NA	NA		20[53]
Potassium Hydroxide	2.00E+03	NA	NA	2.00E+03	NA	NA	NA	NA	NA		
Potassium Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Potassium Silver Cyanide	NA	NA	NA	NA	NA	NA	2.77E+01	NA	NA		20[53]
Promecarb	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Propane	NA	NA	1.80E+06	1.80E+06	NA	NA	NA	NA	NA		
Propane Sultone, 1,3-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Propargyl Bromide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Propiolactone, Beta-	NA	NA	1.50E+03	NA	NA	NA	NA	NA	NA		
Propionaldehyde	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Propionitrile	NA	NA	NA	1.40E+04	NA	NA	NA	NA	NA		
Propionitrile, 3-Chloro-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Propiophenone, 4-Amino-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Propoxur (Baygon)	NA	NA	5.00E+02	5.00E+02	NA	NA	6.93E+00	NA	NA		50[53]
Propyl Adipate, di-N-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Propyl Chloroformate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Propylbenzene, 1-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Propylene Dichloride (1,2-Dichloropropane)	NA	NA	3.47E+05	NA	NA	NA	3.20E+00	NA	4.12E-02	B2	80[53]
Propylene Oxide	NA	NA	4.80E+04	NA	NA	NA	2.40E+01	3.70E-06	2.40E-01	B2	80[53]
Propyleneimine	NA	NA	4.70E+03	5.00E+03	NA	NA	NA	NA	NA		
Prothoate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Pyrene	NA	NA	NA	NA	NA	NA	3.22E+01	NA	NA	D	31[1]
Pyridine, 2-Methyl-5-Vinyl-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Pyridine, 4-Amino-	NA	NA	NA	NA	NA	NA	3.47E-02	NA	NA	D	50[53]
Pyridine, 4-Nitro-, 1-Oxide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Pyriminil	NA	NA	NA	NA	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Date Printed - 04/10/95

Chemical:	1 Minute (µg/m³)	15 Minute (µg/m³)	8 Hour (µg/m³)	10 Hour (µg/m³)	24 Hour (µg/m³)	RCRA (µg/m³)	Noncancer Control Limit (µg/m³)	Unit Risk (µg/m³)-1	Cancer Control Limit (µg/m³)	EPA Cancer Classification	Absorption Factor (%)
Quinoline	NA	NA	NA	NA	NA	NA	NA	NA	1.46E-03	C	50[53]
Quinone	NA	NA	4.00E+02	4.00E+02	NA	NA	NA	NA	NA		
RDX (Cyclo-1,3,5-trimethylene-2,4,6-trinitramine)	NA	3.00E+03	1.50E+03	1.50E+03	NA	NA	5.20E-01	NA	1.59E-02	C	6[52]
Radionuclides (Includes radon, See entries for specific compounds)	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Resorcinol	NA	9.00E+04	4.50E+04	4.50E+04	NA	NA	NA	NA	NA		
Salane, (4-Aminobutyl)diethoxymethyl-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Salcomine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Salicylic Acid	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Sarin	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Selenious Acid	NA	NA	2.00E+02	2.00E+02	NA	NA	3.47E+00	NA	NA	D	20[53]
Selenium	NA	NA	2.00E+02	2.00E+02	NA	NA	7.62E+00	NA	NA	D	44[32]
Selenium Compounds (as Se)	NA	NA	2.00E+02	2.00E+02	NA	NA	3.35E+00	NA	NA		44[32]
Selenium Oxychloride	NA	NA	2.00E+02	2.00E+02	NA	NA	NA	NA	NA		
Semicarbazide Hydrochloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Silane, Trichloro(chloromethyl)-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Silane, Trichloro(dichlorophenyl)-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Silicon	NA	NA	5.00E+03	5.00E+03	NA	NA	NA	NA	NA		
Silicon (Total dust)	NA	NA	1.00E+04	1.00E+04	NA	NA	NA	NA	NA		
Silver (Metal dust and fume)	NA	NA	1.00E+01	NA	NA	NA	NA	NA	NA	D	
Silver (Metal dust and soluble compounds)	NA	NA	NA	1.00E+01	NA	NA	NA	NA	NA		
Silver (Metal dust, soluble compounds, and fumes)	NA	NA	1.00E+01	NA	NA	NA	NA	NA	NA		
Silver (Soluble compounds)	NA	NA	1.00E+01	1.00E+01	NA	NA	NA	NA	NA		
Silver (metal)	NA	NA	1.00E+02	1.00E+01	NA	NA	3.12E+00	NA	NA	D	18[33]
Sodium Arsenate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Sodium Arsenite	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Sodium Azide	2.90E+02	NA	NA	NA	NA	NA	2.77E+00	NA	NA		20[53]
Sodium Cacodylate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Sodium Cyanide	5.00E+03	NA	NA	NA	NA	NA	1.11E+02	NA	NA		80[53]
Sodium Fluoroacetate	NA	1.50E+02	5.00E+01	NA	NA	NA	3.47E-02	NA	NA		50[53]
Sodium Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Sodium Selenate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Sodium Selenite	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Sodium Tellurite	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Stannane, Acetoxytriphenyl-	NA	NA	NA	NA	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk ($\mu g/m^3$)-1	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Strontium	NA	NA	NA	NA	NA	NA	4.16E+02	NA	NA		20[53]
Strychnine	NA	NA	1.50E+02	1.50E+02	NA	NA	5.20E-01	NA	NA		50[53]
Strychnine Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Styrene	8.52E+05	4.26E+05	2.13E+05	2.15E+05	NA	NA	8.00E+02	NA	NA		80[53]
Styrene Oxide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Sulfotep (Tetraethyldithiopyrophosphate or TEDP)	NA	NA	2.00E+02	2.00E+02	NA	NA	8.66E-01	NA	NA		50[53]
Sulfoxide, 3-Chloropropyl octyl	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Sulfur	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Sulfur Dioxide	NA	1.30E+04	5.20E+03	5.00E+03	3.67E-01	NA	NA	NA	NA		
Sulfur Dioxide, Anhydrous	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Sulfur Tetrafluoride	4.00E+02	NA	NA	NA	NA	NA	NA	NA	NA		
Sulfur Trioxide	NA	NA	NA	NA	3.65E+02	NA	NA	NA	NA		
Sulfuric Acid	NA	NA	1.00E+03	1.00E+03	NA	NA	NA	NA	NA		
TEPP	NA	NA	4.70E+01	5.00E+01	NA	NA	NA	NA	NA		
Tabun	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Tellurium	NA	NA	1.00E+02	1.00E+02	NA	NA	NA	NA	NA		
Tellurium Hexafluoride	NA	NA	1.00E+02	2.00E+02	NA	NA	NA	NA	NA		
Terbufos	NA	NA	NA	NA	NA	NA	4.33E-02	NA	NA	D	50[53]
Terpinene, alpha-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Terpinene, delta-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Terpinolene	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	NA	NA	NA	NA	NA	NA	NA	3.30E-05	1.17E-08	B2	50[52]
Tetrachloroethane, 1,1,2,2-	NA	NA	6.90E+03	7.00E+03	NA	2.00E-01	NA	5.80E-05	1.40E-01	C	70[34]
Tetrachloroethylene (Perchloroethylene)	1.38E+06	NA	1.70E+05	NA	NA	1.00E-00	3.47E+01	NA	NA		100[44]
Tetranitromethane	NA	NA	4.00E+01	8.00E+03	NA	NA	NA	NA	NA		
Tetryl (Trinitro-2,4-6-phenylmethylnitramine)	NA	NA	1.50E+03	1.50E+03	NA	NA	2.08E+01	NA	NA		50[52]
Thallium Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Thallous Carbonate	NA	NA	NA	NA	NA	NA	1.39E-01	NA	NA	D	50[53]
Thallous Chloride	NA	NA	NA	NA	NA	NA	5.54E-02	NA	NA	D	20[53]
Thallous Malonate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Thallous Sulfate	NA	NA	NA	NA	NA	NA	5.54E-02	NA	NA	D	20[53]
Thiocarbazide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Thiofanox	NA	NA	NA	NA	NA	NA	5.20E-01	NA	NA		50[53]
Thionazin	NA	NA	NA	NA	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Chemical:	1 Minute (µg/m³)	15 Minute (µg/m³)	8 Hour (µg/m³)	10 Hour (µg/m³)	24 Hour (µg/m³)	RCRA (µg/m³)	Noncancer Control Limit (µg/m³)	Unit Risk (µg/m³)-1	Cancer Control Limit (µg/m³)	EPA Cancer Classification	Absorption Factor (%)
Thiophenol	NA	NA	NA	NA	NA	NA	1.73E-02	NA	NA		50[53]
Thiosemicarbazide	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Thiourea, (2-Chlorophenyl)-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Thiourea, (2-Methylphenyl)-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Tin (Metal)	NA	NA	2.00E+03	2.00E+03	NA	NA	NA	NA	NA		
Tin (Organic compounds)	NA	NA	1.00E+02	1.00E+02	NA	NA	NA	NA	NA		
Tin (Oxide and inorganic compounds except SnH4)	NA	NA	2.00E+03	2.00E+03	NA	NA	NA	NA	NA		
Tin (and compounds)	NA	NA	NA	NA	NA	NA	4.16E+02	NA	NA		20[53]
Tin (inorganic compounds except oxides)	NA	NA	2.00E+03	2.00E+03	NA	NA	NA	NA	NA		
Tin, Tetraethyl	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Titanium	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Titanium Tetrachloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Toluene	1.13E+06	5.60E+05	1.88E+05	3.75E+05	NA	7.00E+03	3.20E+02	NA	NA	D	80[35]
Toluene 2,6-Diisocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Toluene Diamine, 2,4-	NA	NA	NA	NA	NA	NA	NA	NA	4.38E-04	B2	50[53]
Toluene Diisocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Toluene, 2,4-Diisocyanate	1.40E+02	NA	3.60E+01	NA	NA	NA	NA	NA	NA		
Toluidine, o-	NA	NA	8.80E+03	NA	NA	NA	NA	NA	7.29E-03	B2	50[53]
Toxaphene (Chlorinated camphene)	NA	NA	5.00E+02	NA	NA	3.00E-03	NA	3.20E-04	1.50E-03	B2	50[53]
Triacetin	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Triamiphos	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Triazofos	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Trichloroacetyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Trichlorobenzene, 1,2,4-	3.70E+04	NA	NA	NA	NA	1.00E+01	1.00E+02	NA	NA	D	50[53]
Trichloroethane, 1,1,2-	NA	NA	4.50E+04	4.50E+04	NA	6.00E-01	1.12E+01	1.60E-05	4.86E-01	C	81[56]
Trichloroethylene	1.08E+06	NA	2.69E+05	NA	NA	NA	NA	NA	NA		
Trichloroethylsilane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Trichloronate	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Trichlorophenol, 2,4,5-	NA	NA	NA	NA	NA	NA	1.73E+02	NA	NA		50[53]
Trichlorophenol, 2,4,6-	NA	NA	NA	NA	NA	2.00E-01	NA	3.10E-06	1.50E-01	B2	50[53]
Trichlorophenylsilane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Triethoxysilane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Triethylamine	NA	NA	4.10E+03	NA	NA	NA	3.50E+00	NA	NA		50[53]
Trifluralin	NA	NA	NA	NA	NA	NA	1.30E+01	NA	2.27E+00	C	50[53]

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk $(\mu g/m^3)^{-1}$	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Trimethyl-3-phenylindane, 1,1,3-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Trimethylbenzene, 1,2,4-	NA	NA	NA	1.25E+05	NA	NA	NA	NA	NA		
Trimethylbenzene, 1,3,5-	NA	NA	NA	1.25E+05	NA	NA	NA	NA	NA		
Trimethylchlorosilane	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Trimethylolpropane Phosphite	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Trimethylpentane, 2,2,3-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Trimethylpentane, 2,2,4-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Trimethylpentane, 2,3,4-	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Trimethyltin Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Trinitroanisole	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Trinitrobenzene, 1,3,5-	NA	NA	NA	NA	NA	NA	8.66E-02	NA	NA		60[53]
Trinitroglycerol	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Trinitrotoluene, 2,4,6-	NA	NA	5.00E+02	5.00E+02	NA	NA	1.04E+00	NA	7.00E-01	C	60[52]
Triphenyltin Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Tris(2-Chloroethyl) Amine	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Uranium	NA	6.00E+02	2.00E+02	2.00E+02	NA	NA	NA	NA	NA		
Uranium (Insoluble compounds)	NA	6.00E+02	2.00E+02	2.00E+02	NA	NA	NA	NA	NA		
Uranium (Natural)	NA	NA	2.00E+02	NA	NA	NA	NA	NA	NA		
Uranium (Soluble and insoluble compounds)	NA	NA	2.00E+02	NA	NA	NA	NA	NA	NA		
Uranium (Soluble compounds)	NA	NA	5.00E+01	5.00E+01	NA	NA	NA	NA	NA		
Uranium Soluble Salts	NA	NA	NA	5.00E+01	NA	NA	4.16E-01	NA	NA		20[53]
Valinomycin	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Vanadium	NA	NA	NA	NA	NA	NA	2.43E-01	NA	NA		1[40, 61]
Vanadium Pentoxide (as V205)	5.00E+01	NA	5.00E+01	NA	NA	NA	6.24E-02	NA	NA		20[53]
Vinyl Acetate	1.50E+04	NA	3.50E+04	NA	NA	NA	1.30E+02	NA	NA		65[54]
Vinyl Bromide	NA	NA	2.20E+04	NA	NA	NA	1.50E+00	3.20E-05	1.59E-02	B2	60[53]
Vinyl Chloride	1.00E+02	1.28E+04	2.56E+03	2.56E+03	NA	NA	NA	8.40E-05	1.17E-02	A	100[41]
Vinylidene Chloride (1,1-Dichloroethylene)	NA	NA	2.00E+04	NA	NA	3.00E-02	3.12E+01	5.00E-05	2.00E-01	C	100[24]
Warfarin	NA	NA	1.00E+02	1.00E+02	NA	NA	5.20E-01	NA	NA		50[53]
Warfarin, Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Xylene (all isomers)	NA	6.55E+05	4.34E+05	4.35E+05	NA	1.00E+03	6.38E+03	NA	NA	D	92[42]
Xylene Dichloride	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Xylene, m-	NA	6.55E+05	4.34E+05	4.35E+05	NA	1.00E+03	5.54E+03	NA	NA		80[53]
Xylene, o-	NA	6.55E+05	4.34E+05	4.35E+05	NA	1.00E+03	5.54E+03	NA	NA		80[53]

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

Chemical:	1 Minute ($\mu g/m^3$)	15 Minute ($\mu g/m^3$)	8 Hour ($\mu g/m^3$)	10 Hour ($\mu g/m^3$)	24 Hour ($\mu g/m^3$)	RCRA ($\mu g/m^3$)	Noncancer Control Limit ($\mu g/m^3$)	Unit Risk $(\mu g/m^3)^{-1}$	Cancer Control Limit ($\mu g/m^3$)	EPA Cancer Classification	Absorption Factor (%)
Xylene, p-	NA	6.55E+05	4.34E+05	4.35E+05	NA	1.00E+03	NA	NA	NA		
Xylenes (isomers and mixture)	NA	6.55E+05	4.34E+05	4.35E+05	NA	1.00E+03	6.38E+03	NA	NA	D	92[42]
Xylenes (isomers and mixture) -m	NA	6.55E+05	4.34E+05	4.35E+05	NA	1.00E+03	5.10E+03	NA	NA		80[53]
Xylenes (isomers and mixture) -o	NA	6.55E+05	4.34E+05	4.35E+05	NA	1.00E+03	5.10E+03	NA	NA		80[53]
Xylenes (isomers and mixture) -p	NA	6.55E+05	4.34E+05	4.35E+05	NA	1.00E+03	NA	NA	NA		
Zinc (metallic)	NA	NA	NA	NA	NA	NA	2.08E+02	NA	NA	D	20[42]
Zinc Oxide (dust)	1.50E+04	NA	5.00E+03	5.00E+03	NA	NA	NA	NA	NA		
Zinc Oxide (fume)	NA	1.00E+04	5.00E+03	5.00E+03	NA	NA	NA	NA	NA		
Zinc Phosphide	NA	NA	NA	NA	NA	NA	2.08E-01	NA	NA		20[53]
Zinc, Dichloro(4,4-dimethyl-5(((methylamino) carbonyl)oxy)imino)pentanenitrile)-(T-4)	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Zirconium (and compounds)	NA	1.00E+04	5.00E+03	5.00E+03	NA	NA	NA	NA	NA		

NOTE: Where 2 or more values were available for the same category, the lowest value is presented (see main database for additional values); 1 minute = Ceiling Limit; 15 minute = STEL; 8 hour = OSHA or ACGIH TWA; 10 hour = NIOSH TWA; 24 hour = Air Quality Standard; Noncancer Control Limit = RfC if available or derived from RfD; Cancer Control Limit is at 10-6 risk if EPA Cancer Classification is A or B and 10-5 risk if Cancer Classification is C

HEALTH AND ENVIRONMENTAL STANDARDS AND ADVISORY CRITERIA

SUPPLEMENTAL WATER/SOIL TABLE

Prepared for:

Hazardous Waste Remedial Action Program

Prepared by:

Chemical Hazard Evaluation Group
Biomedical and Environmental Information Analysis Section
Health Sciences Research Division
Oak Ridge National Laboratory

April 1995

SUPPLEMENTAL TABLES FOR HEALTH AND ENVIRONMENTAL STANDARDS AND ADVISORY CRITERIA

The Supplemental Tables are compilations of standards and advisory criteria which can be used as a convenient reference guide to identify the most restrictive (i.e., conservative) exposure levels for specific exposure routes (air, water, soil), exposure periods (ceiling values, short-term, lifetime), and populations (e.g., children, adults, general public, occupational). This information is contained in two tables, one is specific for air contaminants, the other for water and soil contaminants.

SUPPLEMENTAL WATER/SOIL TABLE

This table combines information on EPA Drinking Water Standards and Health Advisories, with RCRA Action Levels, Ambient Water Quality Criteria, RfDs and Cancer Control Limits. Descriptions of endpoints are as follows (values in mg/L water and mg/kg soil):

Child One Day:	This value is the One-Day Health Advisory for children issued by EPA.
Child Ten Day:	This value is the Ten-Day Health Advisory for children issued by EPA.
Adult Long Term:	This value is the Long Term Health Advisory for adults issued by EPA.
Child Long Term:	This value is the Long Term Health Advisory for children issued by EPA.
Adult Lifetime:	This value is the Life Time Health Advisory for adults issued by EPA.
RCRA Water Action Level:	This value is the RCRA Action Level for contaminated water.
MCL:	This is EPA's Maximum Contaminant Level for drinking water.
Human Health Fish/Water	This value is the Ambient Water Quality Criterion for Human Health based on ingestion of contaminated fish and drinking water.
Control Limit Noncancer:	This value is the water concentration which would result in a daily dose equivalent to the oral Reference Dose (RfD) adopted by EPA.
Control Limit Cancer:	This value is the water concentration associated with a cancer risk of 10^{-6} if contaminant is in EPA Cancer Classification A or B, or with a risk of 10^{-5} if the contaminant is in class C.

RCRA Soil Action Level:	This value is the RCRA Action Level for soil contamination.
Control Limit Soil/Noncancer:	This value is the soil concentration which would result in a daily dose equivalent to the oral Reference Dose (RfD) for adult soil ingestion.
Control Limit Soil/Cancer:	This value is the soil concentration associated with a cancer risk of 10^{-6} for soil ingestion if contaminant is in EPA Cancer Classification A or B, or with a risk of 10^{-5} if the contaminant is in class C.
EPA Cancer Classification:	This is the classification used to derive the Cancer Control Limit.

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
ANTU	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Acetaldehyde	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Acetamide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Acetone Cyanohydrin	NA	NA	NA	NA	NA	NA	NA	NA	2.43E+00	NA	NA	4.86E+04	NA	
Acetone Thiosemicarbazide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Acetonitrile	NA	NA	NA	NA	NA	2.00E-01	NA	NA	2.08E-01	NA	5.00E+02	4.16E+03	NA	
Acetophenone	NA	NA	NA	NA	NA	4.00E-00	NA	NA	3.47E+00	NA	8.00E+03	6.93E+04	NA	
Acetylaminofluorene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Acetylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Acrolein	NA	NA	NA	NA	NA	NA	NA	3.20E-01	6.93E-01	NA	NA	1.39E+04	NA	
Acrylamide	1.50E+00	3.00E-01	2.00E-02	2.00E-03	NA	8.00E-06	TT	NA	6.93E-03	7.78E-06	2.00E-01	1.39E+02	1.56E-01	B2
Acrylic Acid	NA	NA	NA	NA	NA	NA	NA	NA	1.73E+01	NA	NA	3.46E+05	NA	
Acrylonitrile	NA	NA	NA	NA	NA	6.00E-05	NA	5.90E-05	3.47E-02	NA	1.00E-00	6.93E+02	NA	
Acrylyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Adiponitrile	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Aldicarb	NA	NA	NA	NA	7.00E-03	5.00E-02	3.00E-03	NA	3.47E-02	NA	1.00E+02	6.93E+02	NA	
Aldrin	3.00E-04	3.00E-04	3.00E-04	3.00E-04	NA	2.00E-06	NA	1.30E-07	1.04E-03	2.06E-06	4.00E-02	2.08E+01	4.12E-02	B2
Allyl Alcohol	NA	NA	NA	NA	NA	2.00E-01	NA	NA	1.73E-01	NA	4.00E+02	3.46E+03	NA	
Allyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Allylamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Aluminum (alkyls)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Aluminum (metal dust, respirable fraction)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Aluminum (pyro powders)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Aluminum (soluble salts)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Aluminum (welding fume)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Aluminum Phosphide	NA	NA	NA	NA	NA	1.00E-02	NA	NA	1.39E-02	NA	3.00E+01	2.77E+02	NA	
Aminobiphenyl, 4-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Aminopterin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Amiton	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Amiton Oxalate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ammonia	NA	NA	NA	NA	3.00E+01	NA	NA	NA	NA	NA	NA	NA	NA	
Ammonium Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ammonium Picrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Amphetamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Aniline	NA	NA	NA	NA	NA	6.00E-03	NA	NA	NA	6.14E-03	1.00E+02	NA	1.23E+02	B2
Aniline, 2,4,6-Trimethyl-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Anisidine, o-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Anthracene	NA	NA	NA	NA	NA	NA	NA	9.60E-03	1.04E+01	NA	NA	2.08E+05	NA	
Antimony	1.00E-02	1.00E-02	1.50E-02	1.00E-02	3.00E-03	1.00E-02	6.00E-03	1.40E-02	1.39E-02	NA	3.00E+01	2.77E+02	NA	
Antimony Compounds (as Sb)	1.00E-02	1.00E-02	1.50E-02	1.00E-02	3.00E-03	1.00E-02	6.00E-03	1.40E-02	1.39E-02	NA	3.00E+01	2.77E+02	NA	
Antimony Pentafluoride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Antimycin A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Arsenic	NA	NA	NA	NA	NA	Use MCL	5.00E-02	1.80E-05	1.04E-02	NA	8.00E+01	2.08E+02	NA	
Arsenic (Inorganic compounds)	NA	NA	NA	NA	NA	NA	NA	NA	1.04E-02	NA	NA	2.08E+02	NA	
Arsenic (Organic compounds)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Arsenic Pentoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Arsenous Oxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Arsenous Trichloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Arsine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Azinphos-Ethyl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
Azinphos-Methyl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Barium	NA	NA	NA	NA	2.00E+00	Use MCL	2.00E+00	NA	2.43E+00	NA	4.00E+03	4.85E+04	NA	
Barium (Soluble compounds)	NA	NA	NA	NA	NA	NA	2.00E+00	NA	NA	NA	NA	NA	NA	
Barium Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Benzal Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Benzenamine, 3-(Trifluoromethyl)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Benzene	2.00E-01	2.00E-01	NA	NA	NA	NA	5.00E-03	1.20E-03	NA	1.21E-03	NA	NA	2.41E+01	A
Benzene, 1-(Chloromethyl)-4-nitro-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Benzenearsonic Acid	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Benzidine	NA	NA	NA	NA	NA	2.00E-07	NA	1.20E-07	1.04E-01	1.52E-07	3.00E-03	2.08E+03	3.04E-03	A
Benzimidazole, 4,5-Dichloro-2-(trifluoromethyl)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	2.80E-06	NA	NA	NA	NA	NA	
Benzo(a)pyrene (also see Coal Tar Pitch Volatiles)	NA	NA	NA	NA	NA	NA	2.00E-04	2.80E-06	NA	4.79E-06	NA	NA	9.59E-02	B2
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	2.80E-06	NA	NA	NA	NA	NA	
Benzo(c)acridine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	2.80E-06	NA	NA	NA	NA	NA	
Benzotrichloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.69E-06	NA	NA	5.38E-02	B2
Benzyl Alcohol	NA	NA	NA	NA	NA	NA	NA	NA	1.04E+01	NA	NA	2.08E+05	NA	
Benzyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.06E-04	NA	NA	4.12E+00	B2
Benzyl Cyanide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Beryllium	3.00E+01	3.00E+01	2.00E+01	4.00E+00	NA	8.00E-06	4.00E-03	NA	1.73E-01	8.14E-06	2.00E-01	3.46E+03	1.63E-01	B2
Beryllium Compounds (as Be)	3.00E+01	3.00E+01	2.00E+01	4.00E+00	NA	8.00E-06	4.00E-03	NA	1.73E-01	8.14E-06	2.00E-01	3.46E+03	1.63E-01	B2
Bicyclo [2.2.1] Heptane-2-carbonitrile, 5-chlor-6-(((methylamino)carbonyl) oxy)imino)-(1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Biphenyl (diphenyl)	NA	NA	NA	NA	NA	NA	NA	NA	1.73E+00	NA	NA	3.46E+04	NA	
Bitoscanate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Boric Acid	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Boron	4.00E+00	9.00E-01	3.00E+00	9.00E-01	6.00E-01	NA	NA	NA	3.12E+00	NA	NA	6.24E+04	NA	
Boron Trichloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Boron Trifluoride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Boron Trifluoride Compound with Methyl Ether (1:1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Bromadiolone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Bromine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Bromoform	5.00E+00	2.00E+00	6.00E+00	2.00E+00	NA	7.00E-01	NA	4.30E-03	6.93E-01	4.43E-03	2.00E+03	1.39E+04	8.86E+01	B2
Butadiene, 1,3-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Butane, i-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Butane, n-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Butene, 1-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Butene, cis-2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Butene, i-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Butene, trans-2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Butyl benzyl phthalate	NA	NA	NA	NA	NA	7.00E-00	NA	NA	6.93E+00	NA	2.00E+04	1.39E+05	NA	
Butylbenzene, sec-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Butylphenol, 2,2-Methylene bis(4-methyl) 6-t-butylphen-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cadmium	4.00E-02	4.00E-02	2.00E-02	5.00E-03	5.00E-03	Use MCL	5.00E-03	NA	1.73E-02	NA	4.00E+01	3.46E+02	NA	
Cadmium (dust)	4.00E-02	4.00E-02	2.00E-02	5.00E-03	5.00E-03	NA	5.00E-03	NA	NA	NA	NA	NA	NA	
Cadmium (dusts and salts)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cadmium (fume)	4.00E-02	4.00E-02	2.00E-02	5.00E-03	5.00E-03	NA	NA	NA	NA	NA	NA	NA	NA	
Cadmium Compounds (as Cd)	4.00E-02	4.00E-02	2.00E-02	5.00E-03	5.00E-03	Use MCL	5.00E-03	NA	1.73E-02	NA	4.00E+01	3.46E+02	NA	
Cadmium Oxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
Cadmium Stearate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Calcium Arsenate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Calcium Cyanamide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Calcium Stearate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Camphechlor	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.18E-05	NA	NA	6.36E-01	B2
Cantharidin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Caprolactam (dust)	NA	NA	NA	NA	NA	NA	NA	NA	1.73E+01	NA	NA	3.46E+05	NA	
Captan	NA	NA	NA	NA	NA	NA	NA	NA	4.50E+00	1.00E-02	NA	9.01E+04	2.00E+02	B2
Carbachol Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Carbamic Acid, Methyl, 0-(((2,4-dimethyl-1, 3-dithiolan-2-yl) methylene)amino)-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Carbaryl	1.00E+00	1.00E+00	1.00E+00	1.00E+00	7.00E-01	NA	NA	NA	3.47E+00	NA	NA	6.93E+04	NA	
Carbofuran	5.00E-02	5.00E-02	2.00E-01	5.00E-02	4.00E-02	NA	4.00E-02	NA	1.73E-01	NA	NA	3.46E+03	NA	
Carbon Disulfide	NA	NA	NA	NA	NA	4.00E-00	NA	NA	3.47E+00	NA	8.00E+03	6.93E+04	NA	
Carbon Monoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Carbon Tetrachloride	4.00E+00	2.00E-01	3.00E-01	7.00E-02	NA	3.00E-04	5.00E-03	2.50E-04	2.43E-02	2.69E-04	5.00E-00	4.85E+02	5.38E+00	B2
Carbonyl Sulfide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Carbophenothion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Carene, delta-3-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Catechol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Chloracetic Acid	NA	NA	NA	NA	NA	NA	NA	NA	6.93E-02	NA	NA	1.39E+03	NA	
Chloramben	3.00E+00	3.00E+00	5.00E-01	2.00E-01	1.00E-01	NA	NA	NA	5.20E-01	NA	NA	1.04E+04	NA	
Chlordane	6.00E-02	6.00E-02	NA	NA	NA	3.00E-05	2.00E-03	5.70E-07	2.08E-03	2.69E-05	5.00E-01	4.16E+01	5.38E-01	B2
Chlorfenvinfos	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Chlorine	NA	NA	NA	NA	NA	NA	NA	NA	3.47E+00	NA	NA	6.93E+04	NA	
Chlormephos	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Chlormequat Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Chloroacetophenone, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Chlorobenzene	2.00E+00	2.00E+00	7.00E+00	2.00E+00	1.00E-01	7.00E-01	1.00E-01	6.80E-01	6.93E-01	NA	2.00E+03	1.39E+04	NA	
Chlorobenzilate	NA	NA	NA	NA	NA	NA	NA	NA	6.93E-01	1.30E-04	NA	1.39E+04	2.59E+00	B2
Chloroethanol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Chloroethyl Chloroformate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Chloroform	4.00E+00	4.00E+00	4.00E-01	1.00E-01	NA	6.00E-03	NA	5.70E-03	3.47E-01	5.74E-03	1.00E+02	6.93E+03	1.15E+02	B2
Chloromethyl Ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.59E-07	NA	NA	3.18E-03	A
Chloromethyl Methyl Ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Chlorophacinone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Chloroprene	NA	NA	NA	NA	NA	NA	NA	NA	6.93E-01	NA	NA	1.39E+04	NA	
Chloropropane, 1,2-dibromo-3-	2.00E-01	5.00E-02	NA	NA	NA	NA	2.00E-04	NA	NA	2.50E-05	NA	NA	5.00E-01	B2
Chlorothiophos	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Chloroxuron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Chromic Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Chromium	1.00E+00	1.00E+00	8.00E-01	2.00E-01	1.00E-01	NA	1.00E-01	NA	NA	NA	NA	NA	NA	
Chromium Compounds (As Cr) (does not include Cr VI cmpds)	1.00E+00	1.00E+00	8.00E-01	2.00E-01	1.00E-01	NA	1.00E-01	NA	NA	NA	NA	NA	NA	
Chrysene	NA	NA	NA	NA	NA	NA	NA	2.80E-06	NA	NA	NA	NA	NA	
Coal Tar Pitch Volatiles (as benzene solubles)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cobalt Carbonyl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cobalt Compounds	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cobalt, ((2,2-(1,2-Ethanediylbis (nitrilo-methylidyne))Bis (6-fluorophenolato))(2-)-NNOO)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
Coke Oven Emissions	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Colchicine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Copper	NA	NA	NA	NA	NA	NA	1.30E+00	NA	NA	NA	NA	NA	NA	
Copper (dusts and mists)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Copper (fume)	NA	NA	NA	NA	NA	NA	1.30E+00	NA	NA	NA	NA	NA	NA	
Coumaphos	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Coumatetralyl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cresols/Cresylic Acid (isomers and mixture) (cresol)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cresols/Cresylic Acid (isomers and mixture) (m-cresol)	NA	NA	NA	NA	NA	2.00E-00	NA	NA	1.73E+00	NA	4.00E+03	3.46E+04	NA	
Cresols/Cresylic Acid (isomers and mixture) (o-cresol)	NA	NA	NA	NA	NA	2.00E-00	NA	NA	1.73E+00	NA	4.00E+03	3.46E+04	NA	
Cresols/Cresylic Acid (isomers and mixture) (p-cresol)	NA	NA	NA	NA	NA	2.00E-00	NA	NA	1.73E-01	NA	4.00E+03	3.46E+03	NA	
Crimidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Crotonaldehyde	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Crotonaldehyde, (E)-	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.84E-04	NA	NA	3.68E+00	C
Cumene (Isopropylbenzene)	NA	NA	NA	NA	NA	NA	NA	NA	1.39E+00	NA	NA	2.77E+04	NA	
Cyanide Compounds (as free cyanide)	2.00E-01	2.00E-01	8.00E-01	2.00E-01	2.00E-01	7.00E-01	2.00E-01	7.00E-01	6.93E-01	NA	2.00E+03	1.39E+04	NA	
Cyanogen Bromide	NA	NA	NA	NA	NA	3.00E-00	NA	NA	3.12E+00	NA	7.00E+03	6.24E+04	NA	
Cyanogen Iodide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cyanophos	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cyanuric Fluoride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cycloheximide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cyclohexylamine	NA	NA	NA	NA	NA	NA	NA	NA	6.93E+00	NA	NA	1.39E+05	NA	
Cyclopentane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cyclopentene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
DDE	NA	NA	NA	NA	NA	1.00E-04	NA	NA	NA	NA	2.00E-00	NA	NA	
DEHP (Bis(2-ethylhexyl)phthalate)	NA	NA	NA	NA	NA	3.00E-03	6.00E-03	1.80E-03	6.93E-01	2.50E-03	5.00E+01	1.39E+04	5.00E+01	B2
Decaborane (14)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Demeton	NA	NA	NA	NA	NA	NA	NA	NA	1.39E-03	NA	NA	2.77E+01	NA	
Demeton-S-Methyl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dialifor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Diazomethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	2.80E-06	NA	NA	NA	NA	NA	
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Diborane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dibutylphthalate	NA	NA	NA	NA	NA	4.00E-00	NA	2.70E+00	3.47E+00	NA	8.00E+03	6.93E+04	NA	
Dichlorobenzene, 1,4- (p)	1.00E+01	1.00E+01	4.00E+01	1.00E+01	7.50E-02	NA	7.50E-02	4.00E-01	NA	1.46E-03	NA	NA	2.92E+01	B2
Dichlorobenzidine, 3,3'-	NA	NA	NA	NA	NA	8.00E-05	NA	4.00E-05	NA	7.78E-05	2.00E-00	NA	1.56E+00	B2
Dichlorobutene, Trans-1,4-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dichloroethyl Ether (Bis(2-chloroethyl)ether)	NA	NA	NA	NA	NA	3.00E-05	NA	3.10E-05	NA	3.18E-05	6.00E-01	NA	6.36E-01	B2
Dichloromethylphenylsilane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dichlorophenoxyacetic Acid, 2,4- (2,4-D) salts and esters	1.00E+00	3.00E-01	4.00E-01	1.00E-01	7.00E-02	4.00E-01	7.00E-02	NA	3.47E-01	NA	8.00E+02	6.93E+03	NA	
Dichloropropene, 1,3-	3.00E-02	3.00E-02	9.00E-02	3.00E-02	NA	1.00E-02	NA	1.00E-02	1.04E-02	1.94E-04	2.00E+01	2.08E+02	3.89E+00	B2
Dichlorvos (DDVP)	NA	NA	NA	NA	NA	NA	NA	NA	1.73E-02	1.21E-04	NA	3.46E+02	2.41E+00	B2
Dicrotophos (Bidrin)	NA	NA	NA	NA	NA	NA	NA	NA	3.47E-03	NA	NA	6.93E+01	NA	
Diepoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Diepoxybutane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Diethanolamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
Diethyl Chlorophospate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Diethyl Phthalate	NA	NA	NA	NA	5.00E+00	3.00E+01	NA	2.30E-02	2.77E+01	NA	6.00E+04	5.54E+05	NA	
Diethyl Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Diethylcarbamazine Citrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Diethylenetriamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Diethylhexylsebacate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Digitoxin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Diglycidyl Ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Digoxin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Diisopropylmethylphosphonate	8.00E+00	8.00E+00	3.00E+01	8.00E+00	6.00E-01	NA	NA	NA	2.77E+00	NA	NA	5.54E+04	NA	
Dimefox	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimethoate	NA	NA	NA	NA	NA	7.00E-01	NA	NA	6.93E-03	NA	2.00E+03	1.39E+02	NA	
Dimethoxybenzidine, 3,3'-	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.60E-03	NA	NA	5.00E+01	B2
Dimethyl Aminoazobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimethyl Carbamoyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimethyl Formamide	NA	NA	NA	NA	NA	NA	NA	NA	3.47E+00	NA	NA	6.93E+04	NA	
Dimethyl Phosphorochloridothioate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimethyl Phthalate	NA	NA	NA	NA	NA	NA	NA	3.13E+02	NA	NA	NA	NA	NA	
Dimethyl Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimethyl-p-Phenylenediamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimethylaniline (N,N-Dimethylaniline)	NA	NA	NA	NA	NA	NA	NA	NA	6.93E-02	NA	NA	1.39E+03	NA	
Dimethylbenzidine, 3,3'-	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.80E-06	NA	NA	7.81E-02	B2
Dimethylbutane, 2,2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimethylbutane, 2,3-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimethyldichlorosilane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimethylhexane, 2,3-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimethylhexane, 2,4-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimethylhydrazine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimethylpentane, 2,4-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimethylphenethylamine, alpha, alpha-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dimetilan	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dinitro-o-cresol, 4,6- and salts	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dinitrobenzene, 1,3-	4.00E-02	4.00E-02	1.40E-01	4.00E-02	1.00E-03	4.00E-03	NA	NA	3.47E-03	NA	6.00E-00	6.93E+01	NA	
Dinitrobenzenes (all isomers)	4.00E-02	4.00E-02	1.40E-01	4.00E-02	1.00E-03	NA	NA	NA	NA	NA	NA	NA	NA	
Dinitrocresol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dinitrophenol, 2,4-	NA	NA	NA	NA	NA	7.00E-02	NA	7.00E-02	6.93E-02	NA	2.00E+02	1.39E+03	NA	
Dinitropyrene, 1,6-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dinitrotoluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dinitrotoluene, 2,4-	5.00E-01	5.00E-01	1.00E+00	3.00E-01	NA	NA	NA	1.10E-04	6.93E-02	NA	NA	1.39E+03	NA	
Dinitrotoluene, 2,6-	4.00E-01	4.00E-01	1.00E+00	4.00E-01	NA	NA	NA	NA	3.47E-02	NA	NA	6.93E+02	NA	
Dinitrotoluene, Mixture	NA	NA	NA	NA	NA	5.00E-05	NA	NA	NA	5.15E-05	1.00E+0	NA	1.03E+00	B2
Dinoseb	3.00E-01	3.00E-01	4.00E-02	1.00E-02	7.00E-03	NA	7.00E-03	NA	3.47E-02	NA	NA	6.93E+02	NA	
Dinoterb	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dioctyl Sebacate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dioxane, 1,4- (1,4-Diethyleneoxide)	4.00E+00	4.00E-01	NA	NA	NA	3.00E-03	NA	NA	NA	3.18E-03	6.00E+01	NA	6.36E+01	B2
Dioxathion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Diphacinone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Diphenylamine	1.00E+00	1.00E+00	1.00E+00	3.00E-01	2.00E-01	9.00E-01	NA	NA	8.66E-01	NA	2.00E+03	1.73E+04	NA	
Diphenylhydrazine, 1,2-	NA	NA	NA	NA	NA	4.00E-05	NA	4.00E-05	NA	4.38E-05	9.00E-01	NA	8.75E-01	B2
Diphenyloxazole, 2,5-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Diphosphoramide, Octamethyl-	NA	NA	NA	NA	NA	NA	NA	NA	6.93E-02	NA	NA	1.39E+03	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
Disulfoton	1.00E-02	1.00E-02	9.00E-03	3.00E-03	3.00E-04	1.00E-03	NA	NA	1.39E-03	NA	3.00E-00	2.77E+01	NA	
Dithiazanine Iodide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dithiobiuret	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
EPN	NA	NA	NA	NA	NA	NA	NA	NA	3.47E-04	NA	NA	6.93E+00	NA	
Emetine, Dihydrochloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Endosulfan	NA	NA	NA	NA	NA	2.00E-03	NA	NA	2.08E-01	NA	4.00E-00	4.16E+03	NA	
Endothion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Endrin	2.00E-02	2.00E-02	1.00E-02	3.00E-03	2.00E-03	Use MCL	2.00E-03	7.60E-04	1.04E-02	NA	2.00E+01	2.08E+02	NA	
Epichlorohydrin	1.00E-01	1.00E-01	7.00E-02	7.00E-02	NA	4.00E-03	TT	NA	6.93E-02	3.54E-03	7.00E+01	1.39E+03	7.07E+01	B2
Epoxybutane, 1,2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ergocalciferol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ergotamine Tartrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethanesulfonyl Chloride, 2-Chloro	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethanol, 1,2-Dichloro-, Acetate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethion	NA	NA	NA	NA	NA	NA	NA	NA	1.73E-02	NA	NA	3.46E+02	NA	
Ethoprophos	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethybis(2-Chloroethyl)amine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethyl Acrylate	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.29E-04	NA	NA	1.46E+01	B2
Ethyl Benzene	3.00E+01	3.00E+00	3.00E+00	1.00E+00	7.00E-01	4.00E-00	7.00E-01	3.10E+00	3.47E+00	NA	8.00E+03	6.93E+04	NA	
Ethyl Carbamate (Urethane)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethyl Chloride (Chloroethane)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethylcyclohexane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethylene Dibromide (Dibromoethane)	8.00E-03	8.00E-03	NA	NA	NA	4.00E-07	5.00E-05	NA	NA	4.12E-07	8.00E-03	NA	8.24E-03	B2
Ethylene Dichloride (1,2-Dichloroethane)	7.00E-01	7.00E-01	2.60E+00	7.00E-01	NA	Use MCL	5.00E-03	3.80E-04	NA	3.85E-04	8.00E-00	NA	7.69E+00	B2
Ethylene Fluorohydrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethylene Glycol	2.00E+01	6.00E+00	2.00E+01	6.00E+00	7.00E+00	NA	NA	NA	6.93E+01	NA	NA	1.39E+06	NA	
Ethylene Oxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.43E-05	NA	NA	6.86E-01	B1
Ethylene Thiourea	3.00E-01	3.00E-01	4.00E-01	1.00E-01	NA	NA	NA	NA	2.77E-03	3.18E-04	NA	5.54E+01	6.36E+00	B1
Ethylenediamine	NA	NA	NA	NA	NA	NA	NA	NA	6.93E-01	NA	NA	1.39E+04	NA	
Ethyleneimine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethylhexane, 3-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethylidene Dichloride (1,1-Dichloroethane)	NA	NA	NA	NA	NA	NA	7.00E-03	NA	3.47E+00	NA	NA	6.93E+04	NA	
Ethylthiocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethyltoluene, 1-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethyltoluene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ethyltoluene, 3-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Fenamiphos	9.00E-03	9.00E-03	2.00E-02	5.00E-03	2.00E-03	NA	NA	NA	8.66E-03	NA	NA	1.73E+02	NA	
Fenitrothion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Fensulfothion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Fluenetil	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Fluoranthene	NA	NA	NA	NA	NA	NA	NA	3.00E-01	1.39E+00	NA	NA	2.77E+04	NA	
Fluorene	NA	NA	NA	NA	NA	NA	NA	1.30E+00	1.39E+00	NA	NA	2.77E+04	NA	
Fluorine	NA	NA	NA	NA	NA	NA	NA	NA	2.08E+00	NA	NA	4.16E+04	NA	
Fluoroacetamide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Fluoroacetic Acid	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Fluoroacetyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Fluorouracil	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Fonofos	2.00E-02	2.00E-02	7.00E-02	2.00E-02	1.00E-02	NA	NA	NA	6.93E-02	NA	NA	1.39E+03	NA	
Formaldehyde	1.00E+01	5.00E+00	2.00E+01	5.00E+00	1.00E+00	NA	NA	NA	6.93E+00	NA	NA	1.39E+05	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
Formaldehyde Cyanohydrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Formetanate Hydrochloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Formothion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Formparanate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Fosthietan	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Fuberidazole	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Furan	NA	NA	NA	NA	NA	NA	NA	NA	3.47E-02	NA	NA	6.93E+02	NA	
Gallium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Gallium Trichloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Germanium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Glycol Ethers	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
HMX (Cyclotetramethylene Tetranitramine)	5.00E+00	5.00E+00	2.00E+01	5.00E+00	4.00E-01	NA	NA	NA	1.73E+00	NA	NA	3.46E+04	NA	
Heptachlor	1.00E-02	1.00E-02	5.00E-03	5.00E-03	NA	8.00E-06	4.00E-04	2.10E-07	1.73E-02	7.78E-06	2.00E-01	3.46E+02	1.56E-01	B2
Heptane, n-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Hexachlorobenzene	5.00E-02	5.00E-02	2.00E-01	5.00E-02	NA	NA	1.00E-03	7.50E-03	2.77E-02	2.19E-05	NA	5.54E+02	4.38E-01	B2
Hexachlorobutadiene	3.00E-01	3.00E-01	4.00E-01	1.00E-01	1.00E-03	4.00E-03	NA	4.40E-04	NA	4.49E-03	9.00E+01	NA	8.97E+01	C
Hexachlorocyclopentadiene	NA	NA	NA	NA	NA	2.00E-01	5.00E-02	2.40E-01	2.43E-01	NA	6.00E+02	4.85E+03	NA	
Hexachloroethane	5.00E+00	5.00E+00	6.00E-01	1.00E-01	1.00E-03	3.00E-02	NA	1.90E-03	3.47E-02	2.50E-02	8.00E+01	6.93E+02	5.00E+02	C
Hexamethylene-1,6-diisocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Hexamethylenediamine, N,N-dibutyl-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Hexamethylphosphoramide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Hexane, n-	1.00E+01	4.00E+00	1.00E+01	4.00E+00	NA	NA	NA	NA	2.08E+00	NA	NA	4.16E+04	NA	
Hexene, 1-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Hexene, cis-2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Hexene, trans-2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Hydrazine	NA	NA	NA	NA	NA	1.00E-05	NA	NA	NA	1.17E-05	2.00E-01	NA	2.33E-01	B2
Hydrochloric Acid or (Hydrogen chloride)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Hydrocyanic Acid or (Hydrogen cyanide)	2.00E-01	2.00E-01	8.00E-01	2.00E-01	2.00E-01	7.00E-01	NA	NA	6.93E-01	NA	2.00E+03	1.39E+04	NA	
Hydrogen Chloride, Anhydrous	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Hydrogen Fluoride (Hydrofluoric acid)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Hydrogen Peroxide (saturated)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Hydrogen Selenide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Hydrogen Sulfide	NA	NA	NA	NA	NA	NA	NA	NA	1.04E-01	NA	NA	2.08E+03	NA	
Hydroquinone	NA	NA	NA	NA	NA	NA	NA	NA	1.39E+00	NA	NA	2.77E+04	NA	
Iodine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Iron (soluble salts)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Iron, Pentacarbonyl-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Isobenzan	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Isobutyronitrile	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Isocyanic Acid, 3,4-Dichlorophenyl Ester	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Isodrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Isofluorphate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Isophorone	1.50E+01	1.50E+01	1.50E+01	1.50E+01	1.00E-01	9.00E-02	NA	8.40E-03	6.93E+00	3.68E-01	2.00E+03	1.39E+05	7.37E+03	C
Isophorone Diisocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Isoprene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Isopropyl Chloroformate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Isopropymethylpyrazolyl Dimethylcarbamate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ketone, Bis(Chloromethyl)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Lactonitrile	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Lead (inorganic dusts and fume)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
Lead (inorganic)	NA	NA	NA	NA	NA	Use MCL	1.50E-02	NA	NA	NA	NA	NA	NA	
Lead (metal)	NA	NA	NA	NA	NA	NA	1.50E-02	NA	NA	NA	NA	NA	NA	
Lead Azide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Lead Compounds (as Pb)	NA	NA	NA	NA	NA	Use MCL	NA	NA	NA	NA	NA	NA	NA	
Lead Styphnate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Lead, Tetraethyl	NA	NA	NA	NA	NA	4.00E-06	NA	NA	NA	NA	NA	NA	NA	
Lead, Tetramethyl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.00E-03	NA	NA	
Leptophos	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Lewisite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Limonene, delta-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Lindane	1.00E+00	1.00E+00	1.00E-01	3.00E-02	2.00E-04	Use MCL	2.00E-04	1.90E-05	1.04E-02	2.69E-05	5.00E-01	2.08E+02	5.38E-01	B2
Lithium Hydride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Magnesium Oxide (fume)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Maleic Anhydride	NA	NA	NA	NA	NA	4.00E-00	NA	NA	3.47E+00	NA	8.00E+03	6.93E+04	NA	
Malononitrile	NA	NA	NA	NA	NA	NA	NA	NA	6.93E-04	NA	NA	1.39E+01	NA	
Manganese	NA	NA	NA	NA	NA	NA	NA	NA	1.73E-01	NA	NA	3.46E+03	NA	
Manganese (Dust and compounds)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Manganese (fume)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Manganese Compounds (as Mn)	NA	NA	NA	NA	NA	NA	NA	NA	1.73E-01	NA	NA	3.46E+03	NA	
Manganese, Tricarbonyl Methylcyclopentadienyl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Mechlorethamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Mephosfolan	NA	NA	NA	NA	NA	NA	NA	NA	3.12E-03	NA	NA	6.24E+01	NA	
Mercuric Acetate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Mercuric Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Mercuric Oxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Mercury	NA	NA	2.00E-03	NA	2.00E-03	NA	2.00E-03	1.40E-04	NA	NA	NA	NA	NA	
Mercury (Alkyl compounds)	NA	NA	NA	NA	NA	NA	2.00E-03	NA	NA	NA	NA	NA	NA	
Mercury (Aryl & Inorganic compounds)	NA	NA	NA	NA	NA	Use MCL	NA	NA	NA	NA	2.00E+01	NA	NA	
Mercury (Inorganic)	NA	NA	2.00E-03	NA	2.00E-03	NA	2.00E-03	NA	1.04E-02	NA	NA	2.08E+02	NA	
Mercury (vapor)	NA	NA	2.00E-03	NA	2.00E-03	NA	NA	NA	NA	NA	NA	NA	NA	
Mercury Fulminate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methacrolein Diacetate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methacrylic Anhydride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methacrylonitrile	NA	NA	NA	NA	NA	4.00E-03	NA	NA	3.47E-03	NA	6.00E-00	6.93E+01	NA	
Methacryloyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methacryloyloxyethyl Isocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methamidophos	NA	NA	NA	NA	NA	NA	NA	NA	1.73E-03	NA	NA	3.46E+01	NA	
Methane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methanesulfonyl Fluoride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methanol	NA	NA	NA	NA	NA	NA	NA	NA	1.73E+01	NA	NA	3.46E+05	NA	
Methidathion	NA	NA	NA	NA	NA	NA	NA	NA	3.47E-02	NA	NA	6.93E+02	NA	
Methiocarb	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methicarb	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methomyl	3.00E-01	3.00E-01	3.00E-01	3.00E-01	2.00E-01	9.00E-01	NA	NA	NA	NA	NA	NA	NA	
Methoxychlor	5.00E-02	5.00E-02	2.00E-01	5.00E-02	4.00E-02	NA	4.00E-02	NA	8.66E-01	NA	2.00E+03	1.73E+04	NA	
Methoxyethylmercuric Acetate	NA	NA	NA	NA	NA	NA	NA	NA	1.73E-01	NA	NA	3.46E+03	NA	
Methyl 2-Chloroacrylate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl Bromide (Bromomethane)	1.00E-01	1.00E-01	5.00E-01	1.00E-01	1.00E-02	5.00E-02	NA	4.80E-02	4.85E-02	NA	1.00E+02	9.70E+02	NA	
Methyl Chloride (Chloromethane)	9.00E+00	4.00E-01	1.00E+00	4.00E-01	3.00E-03	NA	NA	NA	NA	2.69E-02	NA	NA	5.38E+02	C
Methyl Chloroform (1,1,1-Trichloroethane)	1.00E+02	4.00E+01	1.00E+02	4.00E+01	2.00E-01	3.00E-00	2.00E-01	NA	NA	NA	7.00E+03	NA	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
Methyl Chloroformate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl Ethyl Ketone (2-Butanone)	NA	NA	NA	NA	NA	2.00E-00	NA	NA	2.08E+01	NA	4.00E+03	4.16E+05	NA	
Methyl Hydrazine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl Iodide (Iodomethane)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl Isobutyl Ketone (Hexone)	NA	NA	NA	NA	NA	2.00E-00	NA	NA	1.73E+00	NA	4.00E+03	3.46E+04	NA	
Methyl Isocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl Isothiocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl Mercaptan	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl Methacrylate	NA	NA	NA	NA	NA	NA	NA	NA	2.77E+00	NA	NA	5.54E+04	NA	
Methyl Phenkapton	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl Phosphonic Dichloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl Tert Butyl Ether	3.00E+00	3.00E+00	2.00E+00	5.00E-01	4.00E-02	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl Thiocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl Vinyl Ketone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl-1-Butene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl-1-Butene, 3-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl-1-Pentene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl-1-Pentene, 4-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl-2-Butene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyl-2-Pentene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methylcyclohexane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methylcyclopentane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methylene Chloride (Dichloromethane)	1.00E+01	2.00E+00	NA	NA	NA	5.00E-03	5.00E-03	4.70E-03	2.08E+00	4.67E-03	9.00E+01	4.16E+04	9.33E+01	B2
Methylene Diphenyl Diisocyanate (MDI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methylene bis(2-chloroaniline), 4,4'-	NA	NA	NA	NA	NA	NA	NA	NA	2.43E-02	2.69E-04	NA	4.86E+02	5.38E+00	B2
Methylenedianiline, 4,4'-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methylheptane, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methylhexane, 3-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methylhydantoin, 5-Ethyl-1,3-diglycidyl-5-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methylmercuric Dicyanamide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methylnaphthalene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methylpentane, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methylpentane, 3-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methyltrichlorosilane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Methylnaphthalene, 1-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Mevinphos (Phosdrin)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Mexacarbate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Mineral fibers	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Mitomycin C	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Molybdenum	2.00E-01	2.00E-02	5.00E-02	1.00E-02	4.00E-02	NA	NA	NA	NA	NA	NA	NA	NA	
Molybdenum (Insoluble compounds)	NA	NA	NA	NA	NA	NA	NA	NA	1.73E-01	NA	NA	3.46E+03	NA	
Molybdenum (Soluble compounds)	2.00E-01	2.00E-02	5.00E-02	1.00E-02	4.00E-02	NA	NA	NA	NA	NA	NA	NA	NA	
Monocrotophos	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Monoethylamine (Ethylamine)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Muscimol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Mustard Gas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Myrcene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Naphthalene	5.00E-01	5.00E-01	1.00E+00	4.00E-01	2.00E-02	NA	NA	NA	NA	NA	NA	NA	NA	
Naphthaleneamine, 2-	NA	NA	NA	NA	NA	NA	NA	NA	1.39E+00	NA	NA	2.77E+04	NA	
Naphthylamine, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nickel	1.00E+00	1.00E+00	1.70E+00	5.00E-01	1.00E-01	7.00E-01	1.00E-01	6.10E-01	6.93E-01	NA	2.00E+03	1.39E+04	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
Nickel (Metal)	1.00E+00	1.00E+00	1.70E+00	5.00E-01	1.00E-01	7.00E-01	1.00E-01	6.10E-01	NA	NA	2.00E+03	NA	NA	
Nickel (Refinery dust)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nickel (Soluble compounds)	NA	NA	NA	NA	NA	NA	1.00E-01	NA	NA	NA	NA	NA	NA	
Nickel (Soluble salts)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nickel Carbonyl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nicotine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nicotine Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitric Acid	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitric Oxide	NA	NA	NA	NA	NA	4.00E-00	NA	NA	NA	NA	8.00E+03	NA	NA	
Nitrobenzene	NA	NA	NA	NA	NA	2.00E-02	NA	1.70E-03	1.73E-02	NA	4.00E+01	3.46E+02	NA	
Nitrobiphenyl, 4- (or 4-Nitrodiphenyl)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitrocellulose	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitrocyclohexane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitrodiphenylamine, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitrodiphenylamine, 4-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitrogen Dioxide	NA	NA	NA	NA	NA	4.00E+01	NA	NA	NA	NA	8.00E+04	NA	NA	
Nitroglycerine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitroguanidine	1.00E+01	1.00E+01	4.00E+01	1.00E+01	7.00E-01	NA	NA	NA	3.47E+00	NA	NA	6.93E+04	NA	
Nitromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitronaphthalene, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitrophenol, 4-	8.00E-01	8.00E-01	3.00E+00	8.00E-01	6.00E-02	NA	NA	NA	NA	NA	NA	NA	NA	
Nitrophenol, o-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitropropane, 2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.68E-06	NA	NA	7.37E-02	B2
Nitropyrene, 1-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitroso-N-methylurea, N-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitrosoethylamine, N-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitrosodimethylamine, N-	NA	NA	NA	NA	NA	7.00E-07	NA	6.90E-07	NA	6.86E-07	1.00E-02	NA	1.37E-02	B2
Nitrosodiphenylamine, 4-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nitrosodiphenylamine, N-	NA	NA	NA	NA	NA	7.00E-03	NA	5.00E-03	NA	7.14E-03	1.00E+02	NA	1.43E+02	B2
Nitrosomorpholine, N-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Nonane, n-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Norbormide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Octane, n-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Organorthodium Complex (PMN-82-147)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ouabain	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Oxamyl	2.00E-01	2.00E-01	9.00E-01	2.00E-01	2.00E-01	NA	2.00E-01	NA	8.66E-01	NA	NA	1.73E+04	NA	
Oxetane, 3,3-Bis(chloromethyl)-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Oxydisulfoton	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Ozone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Paraquat	1.00E-01	1.00E-01	2.00E-01	5.00E-02	3.00E-02	NA	NA	NA	1.56E-01	NA	NA	3.12E+03	NA	
Paraquat Methosulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Parathion	NA	NA	NA	NA	NA	2.00E-01	NA	NA	3.47E-01	NA	5.00E+02	6.93E+03	NA	
Parathion, Methyl	3.00E-01	3.00E-01	1.00E-01	3.00E-02	2.00E-03	NA	NA	NA	8.66E-03	NA	NA	1.73E+02	NA	
Paris Green	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Particulates (PM10)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Particulates (PM10, total dust)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Pentaborane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Pentachloronitrobenzene (Quintobenzene)	NA	NA	NA	NA	NA	1.00E-01	NA	NA	1.04E-01	1.35E-03	2.00E+02	2.08E+03	2.69E+01	C
Pentachlorophenol	1.00E+00	3.00E-01	1.00E+00	3.00E-01	NA	1.00E-00	1.00E-03	2.80E-04	1.04E+00	2.92E-04	2.00E+03	2.08E+04	5.83E+00	B2
Pentadecylamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Pentaerythritol Tetranitrate (PETN)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
Pentene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Pentene, 1-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Pentene, cis-2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Pentene, trans-2-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Peracetic Acid	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Perchloromethylmercaptan	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phenanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phenol	6.00E+00	6.00E+00	2.00E+01	6.00E+00	4.00E+00	2.00E+01	NA	2.10E+01	2.08E+01	NA	5.00E+04	4.16E+05	NA	
Phenol, 2,2 Thiobis(4-chloro-6-methyl)-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phenol, 3-(1 Methylethyl)-, Methylcarbamate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phenoxarsine, 10, 10-Oxydi-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phenyl Dichloroarsine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phenyldiisodecyl Phosphite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phenylenediamine, p	NA	NA	NA	NA	NA	NA	NA	NA	6.58E+00	NA	NA	1.32E+05	NA	
Phenylhydrazine Hydrochloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phenylmercury Acetate	NA	NA	NA	NA	NA	3.00E-03	NA	NA	2.77E-03	NA	6.00E-00	5.54E+01	NA	
Phenylsilatrane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phenylthiourea	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phorate	NA	NA	NA	NA	NA	NA	NA	NA	6.93E-03	NA	NA	1.39E+02	NA	
Phosacetim	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phosfolan	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phosgene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phosmet	NA	NA	NA	NA	NA	NA	NA	NA	6.93E-01	NA	NA	1.39E+04	NA	
Phosphamidon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phosphine	NA	NA	NA	NA	NA	1.00E-02	NA	NA	1.04E-02	NA	2.00E+01	2.08E+02	NA	
Phosphonothioic Acid, Methyl-, O-(4-nitrophenyl) O-phenyl ester	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phosphonothioic Acid, Methyl-, O-ethyl O-(4-(methylthio)phenyl) ester	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phosphonothioic Acid, Methyl-, S-(2-(Bis(1-methylethyl)amino)ethyl O-ethyl ester	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phosphoric Acid, Dimethyl 4-(methylthio) phenyl ester	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phosphorothioic Acid, O,O-Dimethyl-S-(2-methylthio)ethyl ester	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phosphorus	NA	NA	NA	NA	1.00E-04	NA	NA	NA	6.93E-04	NA	NA	1.39E+01	NA	
Phosphorus (white, yellow)	NA	NA	NA	NA	1.00E-04	NA	NA	NA	6.93E-04	NA	NA	1.39E+01	NA	
Phosphorus Oxychloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phosphorus Pentachloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phosphorus Pentoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phosphorus Trichloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Phthalic Anhydride	NA	NA	NA	NA	NA	7.00E+01	NA	NA	6.93E+01	NA	2.00E+05	1.39E+06	NA	
Physostigmine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Physotigmine, Salicylate (1:1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Picric acid	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Picrotoxin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Pinene, alpha-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Pinene, beta-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Piperidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Pirimifos, Ethyl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Polychlorinated Biphenyls (Aroclors)	NA	NA	NA	NA	NA	5.00E-06	5.00E-04	NA	NA	4.55E-06	9.00E-02	NA	9.09E-02	B2
Polycylic Organic Matter	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
Polystyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Potassium Arsenide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Potassium Cyanide	NA	NA	NA	NA	NA	2.00E-00	NA	NA	1.73E+00	NA	4.00E+03	3.46E+04	NA	
Potassium Hydroxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Potassium Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Potassium Silver Cyanide	NA	NA	NA	NA	NA	7.00E-00	NA	NA	6.93E+00	NA	2.00E+04	1.39E+05	NA	
Promecarb	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Propane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Propane Sultone, 1,3-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Propargyl Bromide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Propiolactone, Beta-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Propionaldehyde	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Propionitrile	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Propionitrile, 3-Chloro-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Propiophenone, 4-Amino-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Propoxur (Baygon)	4.00E-02	4.00E-02	1.00E-01	4.00E-02	3.00E-03	NA	NA	NA	1.39E-01	NA	NA	2.77E+03	NA	
Propyl Adipate, di-N-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Propyl Chloroformate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Propylbenzene, 1-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Propylene Dichloride (1,2-Dichloropropene)	NA	9.00E-02	NA	NA	NA	NA	5.00E-03	NA	NA	5.15E-04	NA	NA	1.03E+01	B2
Propylene Oxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.46E-04	NA	NA	2.92E+00	B2
Propyleneimine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Prothoate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Pyrene	NA	NA	NA	NA	NA	NA	NA	9.60E-01	1.04E+00	NA	NA	2.08E+04	NA	
Pyridine, 2-Methyl-5-Vinyl-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Pyridine, 4-Amino-	NA	NA	NA	NA	NA	NA	NA	NA	6.93E-04	NA	NA	1.39E+01	NA	
Pyridine, 4-Nitro-, 1-Oxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Pyriminil	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Quinoline	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.92E-05	NA	NA	5.83E-01	C
Quinone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
RDX (Cyclo-1,3,5-trimethylene-2,4,6-trinitramine)	1.00E-01	1.00E-01	4.00E-01	1.00E-01	2.00E-03	NA	NA	NA	1.04E-01	3.18E-03	NA	2.08E+03	6.36E+01	C
Radionuclides (Includes radon, See entries for specific compounds)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Resorcinol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Salane, (4-Aminobutyl)diethoxymethyl-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Salcomine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Salicylic Acid	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Sarin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Selenious Acid	NA	NA	NA	NA	NA	1.00E-01	NA	NA	1.73E-01	NA	2.00E+02	3.46E+03	NA	
Selenium	NA	NA	NA	NA	NA	NA	5.00E-02	NA	1.73E-01	NA	NA	3.46E+03	NA	
Selenium Compounds (as Se)	NA	NA	NA	NA	NA	NA	5.00E-02	NA	1.73E-01	NA	NA	3.46E+03	NA	
Selenium Oxychloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Semicarbazide Hydrochloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Silane, Trichloro(chloromethyl)-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Silane, Trichloro(dichlorophenyl)-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Silicon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Silicon (Total dust)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Silver (Metal dust and fume)	2.00E-01	2.00E-01	2.00E-01	2.00E-01	1.00E-01	NA	NA	NA	NA	NA	NA	NA	NA	
Silver (Metal dust and soluble compounds)	2.00E-01	2.00E-01	2.00E-01	2.00E-01	1.00E-01	NA	NA	NA	NA	NA	NA	NA	NA	
Silver (Metal dust, soluble compounds, and	2.00E-01	2.00E-01	2.00E-01	2.00E-01	1.00E-01	NA	NA	NA	NA	NA	NA	NA	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
fumes)														
Silver (Soluble compounds)	2.00E-01	2.00E-01	2.00E-01	2.00E-01	1.00E-01	NA	NA	NA	NA	NA	NA	NA	NA	
Silver (metal)	2.00E-01	2.00E-01	2.00E-01	2.00E-01	1.00E-01	Use MCL	NA	NA	1.73E-01	NA	2.00E+02	3.46E+03	NA	
Sodium Arsenate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Sodium Arsenite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Sodium Azide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Sodium Cacodylate	NA	NA	NA	NA	NA	NA	NA	NA	1.39E-01	NA	NA	2.77E+03	NA	
Sodium Cyanide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Sodium Fluoroacetate	NA	NA	NA	NA	NA	1.00E-00	NA	NA	1.39E+00	NA	3.00E+03	2.77E+04	NA	
Sodium Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	6.93E-04	NA	NA	1.39E+01	NA	
Sodium Selenate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Sodium Selenite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Sodium Tellurite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Stannane, Acetoxytriphenyl-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Strontium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Strychnine	2.50E+01	2.50E+01	9.00E+01	2.50E+01	1.70E+01	NA	NA	NA	2.08E+01	NA	NA	4.16E+05	NA	
Strychnine Sulfate	NA	NA	NA	NA	NA	1.00E-02	NA	NA	1.04E-02	NA	2.00E+01	2.08E+02	NA	
Styrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Styrene Oxide	2.00E+01	2.00E+00	7.00E+00	2.00E+00	1.00E-01	7.00E-00	1.00E-01	NA	6.93E+00	NA	2.00E+04	1.39E+05	NA	
Sulfotep (Tetraethyldithiopyrophosphate or TEDP)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Sulfoxide, 3-Chloropropyl octyl	NA	NA	NA	NA	NA	NA	NA	NA	1.73E-02	NA	NA	3.46E+02	NA	
Sulfur	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Sulfur Dioxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Sulfur Dioxide, Anhydrous	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Sulfur Tetrafluoride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Sulfur Trioxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Sulfuric Acid	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
TEPP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Tabun	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Tellurium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Tellurium Hexafluoride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Terbufos	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Terpinene, alpha-	5.00E-03	5.00E-03	5.00E-03	1.00E-03	9.00E-04	NA	NA	NA	8.66E-04	NA	NA	1.73E+01	NA	
Terpinene, delta-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Terpinolene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Tetrachloroethane, 1,1,2,2-	1.00E-06	1.00E-07	4.00E-08	1.00E-08	NA	NA	3.00E-08	1.30E-0*	NA	2.33E-10	NA	NA	4.67E-06	B2
Tetrachloroethylene (Perchloroethylene)	NA	NA	NA	NA	NA	2.00E-03	NA	1.70E-04	NA	1.75E-03	4.00E+01	NA	3.50E+01	C
Tetranitromethane	2.00E+00	2.00E+00	5.00E+00	1.00E+00	NA	7.00E-04	5.00E-03	8.00E-04	3.47E-01	NA	1.00E+01	6.93E+03	NA	
Tetryl (Trinitro-2,4,6-phenylmethylnitramine)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Thallium Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	3.47E-01	NA	NA	6.93E+03	NA	
Thallous Carbonate	NA	NA	NA	NA	NA	3.00E-03	NA	NA	NA	NA	6.00E-00	NA	NA	
Thallous Chloride	NA	NA	NA	NA	NA	NA	NA	NA	2.77E-03	NA	NA	5.54E+01	NA	
Thallous Malonate	NA	NA	NA	NA	NA	NA	NA	NA	2.77E-03	NA	NA	5.54E+01	NA	
Thallous Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Thiocarbazide	NA	NA	NA	NA	NA	NA	NA	NA	2.77E-03	NA	NA	5.54E+01	NA	
Thiofanox	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Thionazin	NA	NA	NA	NA	NA	NA	NA	NA	1.04E-02	NA	NA	2.08E+02	NA	
Thiophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Thiosemicarbazide	NA	NA	NA	NA	NA	NA	NA	NA	3.47E-04	NA	NA	6.93E+00	NA	
Thiourea, (2-Chlorophenyl)-	NA	NA	NA	NA	NA	2.00E-01	NA	NA	NA	NA	5.00E+02	NA	NA	
	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
Thiourea, (2-Methylphenyl)-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Tin (Metal)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Tin (Organic compounds)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Tin (Oxide and inorganic compounds except SnH4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Tin (and compounds)	NA	NA	NA	NA	NA	NA	NA	NA	2.08E+01	NA	NA	4.16E+05	NA	
Tin (inorganic compounds except oxides)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Tin, Tetraethyl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Titanium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Titanium Tetrachloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Toluene	2.00E+01	2.00E+00	7.00E+00	2.00E+00	1.00E+00	1.00E+01	1	6.80E+00	6.93E+00	NA	2.00E+04	1.39E+05	NA	
Toluene 2,6-Diisocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Toluene Diamine, 2,4-	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.09E-05	NA	NA	2.19E-01	B2
Toluene Diisocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Toluene, 2,4-Diisocyanate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Toluidine, o-	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.46E-04	NA	NA	2.92E+00	B2
Toxaphene (Chlorinated camphene)	NA	NA	NA	NA	NA	Use MCL	3.00E-03	7.30E-07	NA	3.18E-05	6.00E-01	NA	6.36E-01	B2
Triacetin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Triamiphos	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Triazofos	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trichloroacetyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trichlorobenzene, 1,2,4-	1.00E-01	1.00E-01	5.00E-01	1.00E-01	7.00E-02	7.00E-01	7.00E-02	NA	3.47E-01	NA	2.00E+03	6.93E+03	NA	
Trichloroethane, 1,1,2-	6.00E-01	4.00E-01	1.00E+00	4.00E-01	3.00E-03	6.00E-03	5.00E-03	6.00E-04	1.39E-01	6.14E-03	1.00E+02	2.77E+03	1.23E+02	C
Trichloroethylene	NA	NA	NA	NA	NA	Use MCL	5.00E-03	2.70E-03	NA	NA	6.00E+01	NA	NA	
Trichloroethylsilane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trichloronate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trichlorophenol, 2,4,5-	2.00E-01	2.00E-01	3.00E-01	7.00E-02	5.00E-02	4.00E-00	NA	NA	3.47E+00	NA	8.00E+03	6.93E+04	NA	
Trichlorophenol, 2,4,6-	NA	NA	NA	NA	NA	2.00E-03	NA	2.10E-03	NA	3.18E-03	4.00E+01	NA	6.36E+01	B2
Trichlorophenylsilane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Triethoxysilane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Triethylamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trifluralin	8.00E-02	8.00E-02	3.00E-01	8.00E-02	5.00E-03	NA	NA	NA	2.60E-01	4.55E-02	NA	5.20E+03	9.09E+02	C
Trimethyl-3-phenylindane, 1,1,3-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trimethylbenzene, 1,2,4-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trimethylbenzene, 1,3,5-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trimethylchlorosilane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trimethylolpropane Phosphite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trimethylpentane, 2,2,3-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trimethylpentane, 2,2,4-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trimethylpentane, 2,3,4-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trimethyltin Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trinitroanisole	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Trinitrobenzene, 1,3,5-	NA	NA	NA	NA	NA	NA	NA	NA	1.73E-03	NA	NA	3.46E+01	NA	
Trinitroglycerol	5.00E-03	5.00E-03	5.00E-03	5.00E-03	5.00E-03	NA	NA	NA	NA	NA	NA	NA	NA	
Trinitrotoluene, 2,4,6-	2.00E-02	2.00E-02	2.00E-02	2.00E-02	2.00E-03	NA	NA	NA	1.73E-02	1.17E-02	NA	3.46E+02	2.33E+02	C
Triphenyltin Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Tris(2-Chloroethyl) Amine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Uranium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Uranium (Insoluble compounds)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Uranium (Natural)	NA	NA	NA	NA	NA	NA	2.00E-02	NA	NA	NA	NA	NA	NA	
Uranium (Soluble and insoluble compounds)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Uranium (Soluble compounds)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

Date Printed - 04/10/95

Chemical	Child One Day	Child Ten Day	Adult Long Term	Child Long Term	Adult Lifetime	RCRA Water Action Level	MCL	Human Health Fish/Water	Control Limit Noncancer	Control Limit Cancer	RCRA Soil Action Level	Control Limit Soil/Noncancer	Control Limit Soil/Cancer	EPA Cancer Classification
Uranium Soluble Salts	NA	NA	NA	NA	NA	NA	NA	NA	1.04E-01	NA	NA	2.08E+03	NA	
Valinomycin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	2.43E-01	NA	NA	4.86E+03	NA	
Vanadium Pentoxide (as V2O5)	NA	NA	NA	NA	NA	3.00E-01	NA	NA	3.12E-01	NA	7.00E+02	6.24E+03	NA	
Vinyl Acetate	NA	NA	NA	NA	NA	NA	NA	NA	3.47E+01	NA	NA	6.93E+05	NA	
Vinyl Bromide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Vinyl Chloride	3.00E+00	3.00E+00	5.00E-02	1.00E-02	NA	NA	2.00E-03	2.00E-03	NA	1.84E-05	NA	NA	3.68E-01	A
Vinylidene Chloride (1,1-Dichloroethylene)	2.00E+00	1.00E+00	4.00E+00	1.00E+00	7.00E-03	Use MCL	7.00E-03	5.70E-05	3.12E-01	5.83E-04	1.00E+01	6.24E+03	1.17E+01	C
Warfarin	NA	NA	NA	NA	NA	NA	NA	NA	1.04E-02	NA	NA	2.08E+02	NA	
Warfarin, Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Xylene (all isomers)	4.00E+01	4.00E+01	1.00E+02	4.00E+01	1.00E+01	7.00E+01	1.00E+01	NA	6.93E+01	NA	2.00E+05	1.39E+06	NA	
Xylene Dichloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Xylene, m-	4.00E+01	4.00E+01	1.00E+02	4.00E+01	1.00E+01	7.00E+01	1.00E+01	NA	6.93E+01	NA	2.00E+05	1.39E+06	NA	
Xylene, o-	4.00E+01	4.00E+01	1.00E+02	4.00E+01	1.00E+01	7.00E+01	1.00E+01	NA	6.93E+01	NA	2.00E+05	1.39E+06	NA	
Xylene, p-	4.00E+01	4.00E+01	1.00E+02	4.00E+01	1.00E+01	7.00E+01	1.00E+01	NA	NA	NA	2.00E+05	NA	NA	
Xylenes (isomers and mixture)	4.00E+01	4.00E+01	1.00E+02	4.00E+01	1.00E+01	7.00E+01	1.00E+01	NA	6.93E+01	NA	2.00E+05	1.39E+06	NA	
Xylenes (isomers and mixture) -m	4.00E+01	4.00E+01	1.00E+02	4.00E+01	1.00E+01	7.00E+01	1.00E+01	NA	6.93E+01	NA	2.00E+05	1.39E+06	NA	
Xylenes (isomers and mixture) -o	4.00E+01	4.00E+01	1.00E+02	4.00E+01	1.00E+01	7.00E+01	1.00E+01	NA	6.93E+01	NA	2.00E+05	1.39E+06	NA	
Xylenes (isomers and mixture) -p	4.00E+01	4.00E+01	1.00E+02	4.00E+01	1.00E+01	7.00E+01	1.00E+01	NA	NA	NA	2.00E+05	NA	NA	
Zinc (metallic)	6.00E+00	6.00E+00	1.00E+01	3.00E+00	2.00E+00	NA	NA	NA	1.04E+01	NA	NA	2.08E+05	NA	
Zinc Oxide (dust)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Zinc Oxide (fume)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Zinc Phosphide	NA	NA	NA	NA	NA	1.00E-02	NA	NA	1.04E-02	NA	2.00E+01	2.08E+02	NA	
Zinc, Dichloro(4,4-dimethyl-5(((methylamino) carbonyl)oxy)imino)pentanenitrile)-(T-4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Zirconium (and compounds)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Units expressed as mg chemical/L water.

Units expressed as mg chemical/kg soil.

ABSORPTION FACTOR REFERENCES

Reference Number	Source
1	Rahman, A., J.A. Barrowman and A. Rahimtula. 1986. The influence of bile on the bioavailability of polynuclear aromatic hydrocarbons from the rat intestine. Can. J. Physiol. Pharmacol. 64:1214-1218
2	Venugopal, B. and T.D. Luckey. 1978. Metal Toxicity in Mammals-2. Chemical Toxicity of Metals and Metalloids. Plenum Press. pp. 104-112
3	Kortus, J. 1967. The carbohydrate metabolism accompanying intoxication by aluminum salts in the rat. Experientia 23:912-913
4	Rahman, A., J.A. Barrowman and A. Rahimtula. 1986. The influence of bile on the bioavailability of polynuclear aromatic hydrocarbons from the rat intestine. Can. J. Physiol. Pharmacol. 64:1214-1218
5	Gerber, G.B., J. Maes and B. Eykens. 1982. Transfer of antimony and arsenic to the developing organism. Arch. Toxicol. 49:159-168
6	Bettley, F.R., O'Shea, J.A. 1975. The absorption of arsenic and its relation to carcinoma. Br. J. Dermatology. 92:563. (Cited in Hindmarsh and McCurdy, 1986)
7	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for Barium. ATSDR/U.S. Public Health Service
8	Sabourin, P.J., B.T. Chen, G. Lucier, et al. 1987. Effects of dose on the absorption and excretion of [14C]benzene administered orally or by inhalation in rats and mice. Toxicol. Appl. Pharmacol. 87:325-336
9	HSDB (Hazardous Substances Data Bank). 1994. MEDLARS Online Information Retrieval System, National Library of Medicine. Retrieved March, 1994
10	Furchner, J.E., C.R. Richmond and J.E. London. 1973. Comparative metabolism of radionuclides in mammals: VII. Retention of beryllium in the mouse, rat, monkey and dog. Health Phys. 24:292-300
11	Reeves, A.L. 1965. The absorption of beryllium from the gastrointestinal tract. Arch. Environ. Health 11:209-214
12	Teirlynck, O.A. and J. Belpaire. 1985. Disposition of orally administered di(2-ethylhexyl)phthalate and mono(2-ethylhexyl)phthalate in the rat. Arch. Toxicol. 57(4):226-230
13	Foulkes, E.C. 1986. Absorption of cadmium. In: Handbook of Experimental Pharmacology. Vol. 80, E.C. Foulkes, ed., Springer-Verlag, Berlin, pp. 75-100
14	Nordberg, G.F., T. Kjellstrom and M. Nordberg. 1985. Kinetics and metabolism. In: Cadmium and Health: A Toxicological and Epidemiological Appraisal. Vol. 1. Exposure, Dose, and Metabolism. L. Friberg, C.G. Elinder, T. Kjellstrom and G.F. Nordberg, eds. CRC Press, Boca Raton, FL, pp. 103-178
15	McLellan, J.S., P.R. Flanagan, M.J. Chamberlain and L.S. Valberg. 1978. Measurement of dietary cadmium absorption in humans. J. Toxicol. Environ. Health 4:131-138
16	Shaikh, Z.A. and J.C. Smith. 1980. Metabolism of orally ingested cadmium in humans. In: Mechanisms of Toxicity and Hazard Evaluation, B. Holmstead, et al., eds. Elsevier/North Holland, Amsterdam. pp. 569-574
17	U.S. EPA. 1989. Updated Health Effects Assessment for Carbon Tetrachloride. Prepared for the Office Emergency and Remedial Response, Washington, DC. Environmental Criteria and Assessment Office, Cincinnati, OH
18	ATSDR (Agency for Toxic Substances and Disease Registry). 1990. Toxicological Profile for Chlorobenzene. ATSDR/U.S. Public Health Service
19	Brown, D.M., P.F. Langely, D. Smith, et al. 1974. Metabolism of Chloroform. I. The metabolism of [14C]-chloroform by different species. Xenobiotica 4:151-163

ABSORPTION FACTOR REFERENCES

Reference Number	Source
20	Goyer, R.A. 1991. Toxic Effects of Metals. In: Casarett and Doull's Toxicology: The Basic Science of Poisons, fourth edition. M. O. Ammdur, J. Doull, and C.D. Klaassen, eds. pp. 623-680
21	Venugopal, B. and T.D. Luckey. 1978. Metal Toxicity in Mammals - 2. Chemical Toxicity of Metals and Metalloids. Plenum Press. pp. 104-112.
22	ATSDR (Agency for Toxic Substances and Disease Registry). 1990. Toxicological Profile for Di-n-Butylphthalate. ATSDR/U.S. Public Health Service
23	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for 1,2-Dichloroethane. ATSDR/U.S. Public Health Service
24	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for 1,1-Dichloroethene. ATSDR/U.S. Public Health Service
25	U.S. EPA. 1986. Health and Environmental Effects Profile for Dinitrotoluene. Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office. Cincinnati, OH. ECAO- CIN-P183
26	ATSDR (Agency for Toxic Substances and Disease Registry). 1991. Toxicological Profile for Fluoride, Hydrogen Fluoride, and Fluorine. ATSDR/U.S. Public Health Service
27	U.S. EPA. 1990. Integrated Risk Information System (IRIS). Health Risk Assessment for Manganese. On line. (Verification date 6/21/90). Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH
28	Angelo, M.J., A.B. Pritchard, D.R. Hawkins, et al. 1986. The pharmacokinetics of dichloromethane. I. Disposition in B6C3F1 mice following intravenous and oral administration. Food Chem. Toxicol. 24:965-974
29	Friberg, L. and J. Lener. 1986. Molybenum. In: Handbook on the Toxicology of Metals. 2nd ed. L. Friberg, G.F. Nordberg and V.B. Vouk, eds. Elsevier/North-Holland Biomedical Press, New York. pp. 446-461
30	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Naphthalene. ATSDR/U.S. Public Health Service
31	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Nickel. ATSDR/U.S. Public Health Service
32	Medinsky, M.A., R.G. Cuddihy, R.O. McClellan. 1981. Systemic absorption of selenious acid and elemental selenium aerosols in rats. J. Toxicol. Environ. Health 8:917-928.
33	East, B.W., K. Boddy, E.D. Williams, et al. 1980. Silver retention, total body silver and tissue silver concentrations in argyria associated with exposure to an anti-smoking remedy containing silver acetate. Clin. Exp. Dermatol. 5:305-311
34	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for 1,1,2,2-Tetrachloroethane. ATSDR/U.S. Public Health Service
35	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for Toluene. ATSDR/U.S. Public Health Service
36	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for 1,1,1-Trichloroethane. ATSDR/U.S. Public Health Service
37	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for 1,1,2-Trichloroethane. ATSDR/U.S. Public Health Service
38	Daniel, J.W. 1963. The metabolism of 36Cl-labelled trichloroethylene and tetrachlorethylene in the rat. Biochem. Pharmacol. 12:795-802
39	Curran, G.L. and R.E. Burch. 1967. Biological and health effects of vanadium. In: Proceedings of the Conference on Trace Substances in Environmental Health, D.D. Hemphill Ed. University of Missouri, Columbia, MO, pp. 96-104
40	ICRP (International Commission on Radiological Protection). 1960. Report of Committee II on Permissible Dose for Internal Radiation. Recommendations of the International Commission on Radiological Protection. ICRP Publ. No. 2. Pergamon Press, Oxford, England, p.163

ABSORPTION FACTOR REFERENCES

Reference Number	Source
41	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Vinyl Chloride. ATSDR/U.S. Public Health Service.
42	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Total Xylenes. ATSDR/U.S. Public Health Service
43	U.S. EPA. 1984. Health Effects Assessment for Zinc and Compounds. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC. EPA/540/1-86-048
44	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Tetrachloroethylene. ATSDR/U.S. Public Health Service
45	ATSDR (Agency for Toxic Substances and Disease Registry). 1994. Toxicological Profile for Pentachlorophenol. ATSDR/U.S. Public Health Service
46	U.S. EPA. 1989. Health and Environmental Effects Document for Butyl benzyl phthalate. Prepared for the Office of Solid Waste and Emergency Response, Washington, DC by the Environmental Criteria and Assessment Office, Cincinnati, OH. ECAO-CIN-G081
47	U.S. EPA. 1987. Health and Environmental Effects Profile for Phthalic acid alkyl, aryl, and alkyl/aryl esters. Prepared for the Office of Solid Waste and Emergency Response, Washington, DC by the Environmental Criteria and Assessment Office, Cincinnati, OH. ECAO-CIN-P188
48	U.S. EPA. 1985. Health and Environmental Effects Document for Dichloroethanes. Prepared for the Office of Solid Waste and Emergency Response, Washington, DC by the Environmental Criteria and Assessment Office, Cincinnati, OH. ECAO-CIN-P139
49	U.S. EPA. 1985. Health and Environmental Effects Document for Dichloroethanes. Prepared for the Office of Solid Waste and Emergency Response, Washington, DC by the Environmental Criteria and Assessment Office, Cincinnati, OH. ECAO-CIN-P139
50	U.S. EPA. 1987. Health Effects Assessment for Dichlorobenzenes. Prepared for the Office of Solid Waste and Emergency Response, Washington, DC by the Environmental Criteria and Assessment Office, Cincinnati, OH. ECAO-CIN-H079
51	Curran, G.L. and R.E. Burch. 1967. Biological and health effects of Vanadium. In: D.D. Hemphill Ed. Proceedings of the Conference on Trace Substances in Environmental Health. University of Missouri, Columbia, MO, pp. 96-104
52	Default value established by Brown and Root Environmental.
53	Default value. Taken from "Default Oral Absorption Vaues for Dermal Reference Dose Adjustment," Supplemental Guidance to RAGS" Region IV Bulletin. This document specifies default values of 80% for volatiles, 50% for semi-volatiles, and 20% for inorganic chemicals.
54	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for Vinyl Acetate. ATSDR/U.S. Public Health Service.

ADDITIONAL HEALTH AND ENVIRONMENTAL CRITERIA (ORNL)

NOAELs AND LOAELs FOR POPULATION-RELATED EFFECTS

RDX						
Species	Route	Expos. Period	NOAEL mg/kg/day	LOAEL mg/kg/day	Effect/ Endpoint	Ref.
rat	diet	2 yr	10[a]			Hart, 1976
	diet	2 yr	8[b]	40	mortality	Levine et al., 1984
	diet	13 wk/gen. (2 gen.)	16[c]	50	mortality	Cholakis et al., 1980
	diet	13 wk/gen. (2 gen.)	5	16	reduced pup weight	Cholakis et al., 1980
	gavage	GD 6-19	2	20[d]	toxic to dams and embryos	Cholakis et al., 1980
mouse	diet	2 yr	7	35	testicular degeneration	Lish et al., 1984
rabbit	gavage	GD 7-29	2	20[d]	toxic to dams and embryos	Cholakis et al., 1980

[a] Maximum dose tested.
[b] Inflammation of prostate seen at 1.5 and 8.0 mg/kg/day; NOEL 0.3 mg/kg/day.
[c] No adverse reproductive effects seen at this dose.
[d] No teratogenic effects seen at this dose.

REFERENCES:

Cholakis, J.M., L.C.K. Wong, D.L. Van Goethem, et al. 1980. Mammalian Toxicological Evaluation of RDX. Final Report, AD A092531. Midwest Research Institute, Kansas City, MO. DMD17-78-C-8027.

Hart, E.R. 1976. Two-year Feeding Study in Rats. Final Report, AD A040161. Litton Bionetics Inc., Kensington, MD. N00014-73-C-0162, NR202-043.

Levine, B.S., E. M. Furedi, V.S. Rac, D.E. Gordon and P.M. Lish. 1984. Determination of the Chronic Mammalian Toxicological Effects of RDX: Twenty-four Month Chronic Toxicity/Carcinogenicity Study of Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in the Fischer 344 Rat. Phase V., Vol. 1. AD A160774. IIT Research Institute, Chicago, IL. U.S. Army Medical Research and Development Command. DAMD17-79-C-9161.

Lish, P.M., B.S. Levine, E.M. Furedi, E.M. Sagartz and V.S. Rac. 1984. Determination of the Chronic Mammalian Toxicological Effects of RDX: Twenty-four Month Chronic Toxicity/Carcinogenicity Study of Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in the B6C3F1 Hybrid Mouse. Phase VI., Vol. 1. AD A160774. IIT Research Institute, Chicago, IL. U.S. Army Medical Research and Development Command. DAMD17-79-C-9161.

NOAELs AND LOAELs FOR POPULATION-RELATED EFFECTS

HMX						
Species	Route	Expos. Period	NOAEL mg/kg/day	LOAEL mg/kg/day	Effect/ Endpoint	Ref.
rat	diet	13 wk	4000[a]		mortality	Army, 1985a
rat	diet	13 wk	50	150	hepatic effects	Army, 1985a
mouse	diet	13 wk	90[b]	200	mortality[c]	Army, 1985b

[a] No effects on survival; however, lower doses (150-1500 mg/kg/day) were associated with hematological, hepatic and renal effects.

[b] No histopathological lesions were seen in ovaries or testes; however, reproductive function was not evaluated.

[c] 13/20 deaths in males (12/20 deaths in females at 250 mg/kg/day).

REFERENCES:

Army. 1985a. [Title not given]. AD-A171 601. Available from Defense Technical Information Center. Write to Documents, Cameron Station, Alexandria, VA 22314, or call (703)274-7633. (Cited in U.S. EPA 1992).

Army. 1985b. HMX: 13 weeks toxicity study in mice by dietary administration. Ft. Detrick, MD: U.S. Army Medical Research and Development Command, U.S. Army Medical Bioengineering Research and Development Laboratory. (authored by Everett DL and Maddock SM). (Cited in ASTDR 1994)

ATSDR. 1994. Toxicological Profile for HMX. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. Draft for Public Comment.

U.S. EPA. 1992. Coversheet for HMX. Integrated Risk Information Systems (IRIS) Online. Cincinnati, OH: Office of Health and Environmental Assessment. Updated February, 1993.

NITROCELLULOSE						
Species	Route	Expos. Period	NOAEL mg/kg/day	LOAEL mg/kg/day	Effect/ Endpoint	Ref.
rat	diet	3 gen.	1,280 (males)[a] 1,422 (females)[a]			Ellis et al., 1980
rat	diet	3 gen.		10% in diet[b]		Ellis et al., 1980
rat	diet	2 yr	8,798 (males)[c] 10,373 (females)[c]			Ellis et al., 1976, 1980
mouse	diet	2 yr	5,620 (females)[d]			Ellis et al., 1976, 1980
dog	diet	2 yr	5,135 (males)[c] 5,737 (females)[c]			Ellis et al., 1976, 1980

[a] Equivalent to 3% nitrocellulose in food.
[b] Dose in mg/kg/day could not be calculated; observed effects included a significant reduction in lactation index and in pup weight.
[c] Equivalent to 10% nitrocellulose in food.
[d] Equivalent to 3% nitrocellulose in food.

REFERENCES:

Ellis, H.V., Hagensen, J.H., Hodgson, J.R., et al. 1980. Mammalian toxicity of munitions compounds. Phase III: Effects of Life-Time Exposure. Part III: Nitrocellulose. Progress Report No. 9. Midwest Research Institute, Kansas City, MO. DAMD 17-74-C-4073. 197 pp. (Cited in Ryon 1986)

Ellis, H.V., Kowalski, J.J., Hodgson, J.R., et al. 1976. Mammalian toxicity of munitions compounds. Phase II: Effects of Multiple Doses. Part IV: Nitrocellulose. Progress Report No. 5. Midwest Research Institute, Kansas City, MO. DAMD 17-74-C-4073. 103 pp. (Cited in Ryon 1986)

Ryon, M.G. 1986. Water Quality Criteria for Nitrocellulose. Final Report. U.S. Army Medical Research and Development Command, Fort Detrick, Frederick, MD 21701-5012. U.S. Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, Frederick, MD 21701-5010.

BENZO(A)PYRENE						
Species	Route	Expos. Period	NOAEL mg/kg/day	LOAEL mg/kg/day	Effect/ Endpoint	Ref.
mouse	intubation	GD 7-16	1[a]	10	reproductive and developmental	Mackenzie and Angevine, 1981
mouse	-	6 mo.		120	decr. survival[b]	Robinson et al., 1975

[a] NOAEL estimated from LOAEL (Opresko et al., 1994).
[b] "Nonresponsive strain", i.e., hepatic aryl hydrocarbon hydroxylase not induced by PAHs.

REFERENCES:

ATSDR. 1987. Toxicological Profile for Benzo(a)pyrene. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. Draft for Public Comment.

Mackenzie, K.M. and Angevine, D.M. 1981. Infertility in mice exposed in utero to benzo(a)pyrene. Biol. Reproduc. 24:183-191. (Cited in Opresko et al. 1994)

Opresko, D.M., Sample, B.E., Sutter,II, G.W. 1994. Toxicological Benchmarks for Wildlife 1994.

Robinson, J.R., et al. 1975. Relationship between "aromatic hydrocarbon responsiveness" and the survival time in mice treated with various drugs and environmental compounds. Mol. Pharm. 11:850-865. (Cited in ATSDR, 1987.

Aluminum						
Species	Route	Expos. Period	NOAEL mg Al/kg/day	LOAEL mg Al/kg/day	Effect/ Endpoint	Ref.
Sodium aluminum phosphate						
dog	diet	6 mo	60		reproduction	Katz et al., 1984
Aluminum chloride						
rat	diet	GD 6-19	50		maternal toxicity, teratogenic effect in fetus	McCormack et al., 1979
	diet	GD 8-20		155	death of pups	Bernuzzi et al., 1986
	gavage	6 mo		2.5	decreased spermatozoa counts & motility, testicular changes	Krasovskii et al., 1979
	water	90 d	100		gonadotropin levels; histopathological changes; reproduction	Dixon et al., 1979
mouse	water	3 gen.	19[a]		reproduction	Ondreicka, et al. 1966
Aluminum nitrate						
rat	gavage in water	GD 6-14		14	skeletal malformation, decreased pup weight	Paternain et al., 1988
Aluminum sulfate						
Ringed dove	diet	4 mo	111.4[b]		reproduction	Carriere et al. 1986
Aluminum phosphide						
rat	diet	2 yr	0.43			Nackenburg 1972

[a] Decreased body weight in second and third generations.
[b] NOAEL estimated from dietary level of 1000 ppm Al (Opresko et al., 1994).

REFERENCES:

ATSDR. 1992. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. Toxicological Profile for Aluminum.

Bast, C.B. 1993. Toxicity summary for aluminum. Prepared by Oak Ridge National Laboratory, Oak Ridge, TN. Prepared for Oak Ridge Reservation environmental Restoration Program.

Bernuzzi, V., Desor, D., Lehr, P.R. 1986. Effects of prenatal aluminum exposure on neuromotor maturation in the rat. Neurobeh. Toxicol. Teratol. 8:115-119. (Cited in ATSDR 1992)

Carriere, D., Fischer, K., Peakall, D., et al. 1986. Effects of dietary aluminum in combination with reduced calcium and phosphorus on the ring dove (*Streptopelia risoria*). Water, Air, and Soil Poll. 30:757-764. (Cited in Opresko et al. 1994)

Dixon, R.L., Sherins, R.J., Lee, I.P. 1979. Assessment of environmental factors affecting male fertility. Environ, Health Perspect 30:53-68. (Cited in ATSDR 1992)

Katz, A.C., Frank, D.W., Sauerhoff, M.W. et al. 1984. A 6-month dietary toxicity study of acidic sodium aluminum phosphate in beagle dogs. Food Chem. Toxicol. 22:7-9. (Cited in ATSDR 1992)

Krasovskii, G.N., Vasulovich, L.Y., Charie, O.G. 1979. Experimental study of biological effects of lead and aluminum following oral administration. Environ. Health Perspect. 30:47-51. (Cited in Bast 1993)

McCormack, K.M., Ottosen, L.D., Sanger, V.L., et al. 1979. Effects on prenatal administration of aluminum and parathyroid hormone on fetal development in the rat. Proc. Soc. Exp. Biol. Med. 161:74-77. (Cited in ATSDR 1992)

Nackenburg, U. 1972. Chronic ingestion by rats of standard diet treated with aluminum phosphide. Toxicol. Appl. Pharmacol. 23(1):147-158. (Cited in U.S. EPA 1994)

Ondreicka, R., Ginter, E., Kortus, J. 1966. Chronic toxicity of aluminum in rats and mice and its effects on phosphorus metabolism. British J. Ind. Med. 23:305-312. (Cited in ATSDR 1992)

Opresko, D.M., Sample, B.E., Sutter,II, G.W. 1994. Toxicological Benchmarks for Wildlife 1994. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-86/R1.

Paternain, J.L., Domingo, J.L., Llobet, J.M., et al., 1988. Embryotoxic and teratogenic effects of aluminum nitrate in rats upon oral administration. Teratology 38:253-257. (Cited in ATSDR 1992)

U.S. EPA. 1994. Health Effects Assessment Summary Tables, Annual Update: U.S. Environmental Protection Agency (March 1994).

Zinc						
Species	Route	Expos. Period	NOAEL mg Zn/kg/day	LOAEL mg Zn/kg/day	Effect/ Endpoint	Ref.
Zinc oxide						
rat	diet	gestation period		250	reduced fetal growth, increased stillbirth	Ketcheson et al., 1969
	diet	36 d GD 1-21		200	100% fetal resorption	Schlicker & Cox 1968
	diet	5 mo	50	250	increased stillbirth	Sutton & Nelson, 1937
	diet	3 gen.	250			Heller & Burke, 1927
Zinc dust						
rat	diet	3 gen.	125			Heller & Burke, 1927
Zinc carbonate						
rat	diet	5 mo	50	250	reproduction	Sutton & Nelson, 1937
Zinc sulfate						
rat	diet	18 d GD 0-18		200	preimplantation losses	Pal & Pal, 1987
mink	diet	25 wk	20.8			Bleavins et al., 1983
Zinc acetate						
rat	water	47 wk	25.5			Drinker, 1927

REFERENCES:

ATSDR. 1992. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. 1992. Toxicological Profile for Zinc.

Bleavins, M.R., Aulerich, R.J., Hochstein, J.R., et al. 1983. Effects of excessive dietary zinc on the intrauterine and postnatal development of mink. Nutrition 113:2360-7. (Cited in ATSDR 1992)

Drinker, K.R., Thompson, P.K., Marsh, M. 1927. An investigation of the effect upon rats of long continued ingestion of zinc compounds, with a special reference to the relation of zinc excretion to zinc intake. Am. J. Physiol. 80:284-306. (Cited in Opresko 1992)

Heller, V.G., Burke, A.D. 1927. Toxicity of zinc. J. Biol. Chem. 74:85-93. (Cited in Opresko 1992)

Ketcheson, M.R., Barron, G.P., Cox, D.H. 1969. Relationship of maternal dietary zinc during gestation and lactation to development and zinc, iron, and copper content of the postnatal rat. J. Nutr. 98:303-311. (Cited in Opresko 1992)

Opresko, D.M. 1992. Toxicity summary for zinc and zinc compounds. Prepared by Oak Ridge National Laboratory, Oak Ridge, TN. Prepared for U.S. Army Toxic and Hazardous Material Agency. Aberdeen Proving Ground, MD 21010-5401.

Pal, N., Pal, B. 1987. Zinc feeding and conception in the rats. Int. J. Vitam. nutr. Res. 57:437-440. (Cited in ATSDR 1992)

Schlicker, S.A., Cox, D.H. 1968. Maternal dietary zinc, and development and zinc, iron, and copper content of the rat fetus. J. Nutr. 95:287-294 (Cited in ATSDR 1992)

Sutton, W.R., Nelson, V. E. 1937. Studies on zinc. Proc. Soc. Exp. Biol. Med. 36:211-213. (Cited in ATSDR 1992)

Manganese						
Species	Route	Expos. Period	NOAEL mg Mn/kg/day	LOAEL mg Mn/kg/day	Effect/ Endpoint	Ref.
Manganese dioxide						
mouse	inhalation	4 mo prior through GD 18 5 d/wk 7 hr/d		48.9 mg Mn/m^3	decreased pup weight, impaired neurobehavior	Massaro et al. 1980
	inhalation	18 wk 5 d/wk 7 hr/d		61 mg Mn/m^3	decreased pup weight, altered behavior[b]	Lown et al., 1984
Manganese tetroxide						
rat	diet	through gestation for 240 d	88[a]	280[a]	decreased fertility	Laskey et al., 1982
mouse	diet	90 d		140	delayed testes growth	Gray & Laskey 1980
Manganese chloride						
monkey	gavage	18 mo		6.94	testicular degeneration, interstitial edema	Murthy et al., 1980 U.S. EPA, 1989
rat	water	20 d GD 0-20	620	1240	decreased litter weight	Kontur & Fechter 1988
Manganese sulfate						
rat	diet	103 wk	290	930	mortality	Hejtmancik et al., 1987a
mouse	diet	103 wk	810		mortality	Hejtmancik et al., 1987b

[a] NOAEL and LOAEL estimated from dietary levels of 1100 and 3500 ppm Mn, respectively (Opresko et al., 1994)

[b] No adverse reproductive effects were observed.

REFERENCES:

ATSDR. 1992. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. Toxicological Profile for Manganese.

Francis, A.A. 1991. Toxicity summary for manganese. Prepared by Oak Ridge National Laboratory, Oak Ridge, TN. Prepared for U.S. Army Toxic and Hazardous Material Agency. Aberdeen Proving Ground, MD 21010-5401.

Gray, L.E., Laskey, J.W. 1980. Multivariate analysis of the effects of manganese on the reproductive physiology and behavior of the male house mouse. J. Toxicol. Environ. Health 6:861-867. (Cited in ATSDR 1992)

Hejtmancik, M., Peters, A.C., Toft, J.D., et al. 1987a. The chronic study of manganese sulfate monohydrate (CAS No. 10034-96-5) in F344 rats. Report to National Toxicology Program. Research Triangle Park, NC, By Battelle's Columbus Laboratories, Columbus, OH. (Cited in ATSDR 1992)

Hejtmancik, M., Peters, A.C., Toft, J.D., et al. 1987b. The chronic study of manganese sulfate monohydrate (CAS No. 10034-96-5) in B6C3F1 rats. Report to National Toxicology Program. Research Triangle Park, NC, By Battelle's Columbus Laboratories, Columbus, OH. (Cited in ATSDR 1992)

Kontur, P.J., Fechter, L.D. 1988. Brain regional manganese levels and monoamine metabolism in manganese-treated neonatal rats. Neurotoxicol teratology 10:295-303. (Cited in ATSDR 1992)

Laskey, J.W., Rehnberg, G.L., Hein, J.F., et al. 1982. Effects of chronic manganese (Mn_3O_4) exposure on selected reproductive parameters in rats. J. Toxicol. Environ. Health 9:677-687. (Cited in Opresko et al. 1994)

Lown, B.A., Morganti, J.B., D'Agostino, R., et al. 1984. Effects on the postnatal development of the mouse of preconception, postconception and/or suckling exposure to manganese via maternal inhalation exposure to MnO^2 dust. Neurotoxicology 5:119-129. (Cited in ATSDR 1992)

Massaro, E.J., D'Agostino, R.B., Stineman, C., et al. 1980. Alterations in behavior of adult offsprings of female mice exposed to MnO^2 dust during gestation. Fed. Proc. Fed. Am. Soc. Exp. Biol. 39:623. (Cited in Francis 1991)

Murthy, R.C., Srivastava, R.S., Gupta, S.K., et al. 1980. Manganese induced testicular changes in monkeys. Exp. Path. 18:240-244. (Cited in Francis 1991)

Opresko, D.M., Sample, B.E., Sutter,II, G.W. 1994. Toxicological Benchmarks for Wildlife 1994. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-86/R1.

U.S. EPA. 1989. Reportable Quality Document for Manganese. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response, Washington, DC. (Cited in Francis 1991).

LEAD						
Species	Route	Expos. Period	NOAEL[a] mg Pb/kg/day	LOAEL[a] mg Pb/kg/day	Effect/ Endpoint	Ref.
Lead acetate						
rat	diet	3 gen.	8[b]	80	kidney damage in pups	Azar et al., 1973
rat	diet	22 mo	80[c]	-	survival	API, 1971
rat	diet	2 yr	0.9	3.1	decr. ALAD activity	Azar et al., 1973
rat	gavage	30 days	0.13[d]	0.26	male impotence	Hilderbrand et al., 1973
rat	gavage	30 days	-	0.014	irregular estrous cycle	Hilderbrand et al., 1973
rat	gavage	GD 7-16	39	390	decr. number of pregnancies	Kennedy et al., 1975
rat	water	3 gen.	-	3.25[e]	breeding failure	Schroeder and Mitchener, 1971
rat	water	GD 14 through parturition	-	80[f]	decr. sperm count	McGivern et al., 1991
rat	water	30 days	-	130[g]	reduced sperm count	Sokol and Berman, 1991
rat	water	60 d	22	45	inhib. of spermatogenesis	Chowdhury et al., 1984
mouse	water	3 gen.	-	6.25[e]	breeding failure	Schroeder and Mitchner, 1971
rabbit	diet	GD 7-16	18.6[h]	-	no effect on reproduction	API, 1971
dog	diet	22 mo.	24[f]	-		API, 1971
dog	diet	2 yr	1.25	2.5	decr. ALAD activity	Azar et al., 1973

NOAELs AND LOAELs FOR POPULATION-RELATED EFFECTS

LEAD						
Species	Route	Expos. Period	NOAEL[a] mg Pb/kg/day	LOAEL[a] mg Pb/kg/day	Effect/ Endpoint	Ref.
Lead nitrate						
rat	water	Gestation	0.9	-	no reproductive effects	Hubermont et al., 1976
Metallic lead						
Am. kestrels	diet	7 mo.	3.85[i]	-		Pattee, 1984

[a] Where indicated, NOAELS and LOAELS estimated using methods described in Opresko et al. (1994).
[b] NOAEL estimated from dietary level of 100 ppm Pb.
[c] NOAEL estimated from dietary level of 1000 ppm Pb; changes in kidney and liver seen at this dose.
[d] Increased prostate weight reported at this dose.
[e] LOAEL estimated from water concentration of 25 ppm Pb.
[f] LOAEL estimated from dietary level of 0.1% lead acetate.
[g] LOAEL estimated from water concentration of 0.1% lead acetate.
[h] LOAEL estimated from dietary level of 546 ppm Pb.
[i] NOAEL estimated from dietary level of 50 ppm.

REFERENCES:

API (American Petroleum Institute). 1971. The chronic toxicity of lead. Medical Research Report No. EA7102. Washington, DC.

ATSDR. 1990. Toxicological Profile for Lead. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service.

Azar, A., Trochimowicz, H.J., Maxwell, M.E. 1973. Review of lead studies in animals carried out at Haskell Laboratory: two-year feeding study and response to hemmorhage study. In: Environmental Health Aspects of Lead: Proceedings, International Symposium, D. Barth et al., eds. Commission of European Communities. pp. 199-210. (as cited in ATSDR, 1990 and Opresko et al., 1994).

Chowdhury, A.R., et al. 1984. Toxic effect of lead on the testes of rat. Biomed. Biochim Acta 43:95-100 (as cited in ATSDR, 1990)

Hilderbrand, D.C. 1973. Effect of lead acetate on reproduction. Am. J. Obstet. Gynecol. 115:1058-1065 (as cited in ATSDR, 1988)

Hubermont G., et al. 1976. Effect of short-term administration of lead to pregnant rats. Toxicology 5:379-384. (as cited in ATSDR)

Kennedy, G.L., et al. 1975. Teratogenic evaluation of lead compounds in mice and rats. Food Cosmet. Toxicol. 13:629-632.

McGivern, R.F., et al. 1991. Prenatal lead exposure in the rat during the third week of gestation: Long-term behavioral, physiological, and anatomical effects associated with reproduction. Toxicol. Appl. Pharmacol. 110:206-215.

Opresko, D.M., Sample, B.E., Sutter,II, G.W. 1994. Toxicological Benchmarks for Wildlife 1994.

Pattee, O.H. 1984. Eggshell thickness and reproduction in American kestrels exposed to chronic dietary lead. Arch. Environ. Contam. Toxicol. 13:29-34. (Cited in Opresko et al. 1994)

Schroeder, H.A. and M. Mitchener. 1971. Toxic Effects of trace elements on the reproduction of mice and rats. Arch. Environ. Health 23:102-106.

Sokol, R.Z. and N. Berman. 1991. The effect of age of exposure on lead-induced testicular toxicity. Toxicol. 69:269-278.

2,4-DINITROTOLUENE						
Species	Route	Expos. Period	NOAEL mg/kg/day	LOAEL mg/kg/day	Effect/ Endpoint	Ref.
rat	diet	13 wk	-	34 266	decreased fertility testicular atrophy	Lee et al., 1978
	diet	13 wk	-	206	mortality	Lee et al., 1978
	diet	2 yr	3.9	34	testicular atrophy	Ellis et al., 1979
	diet	2 yr	-	40[a]	mortality	Ellis et al., 1979
	diet	3 gen.	-	34 M 45 F	aspermatogenesis, decreased neonatal viability, absence of second generation, increased hemorrhaging and/or retention of placenta and mortality during parturition	Ellis et al., 1979
	gavage	GD 7-20	-	150[b]	maternal toxicity, increased resorption and fetal death	Price et al., 1985
mouse	diet	13 wk	47	137	testicular degeneration	Lee et al., 1978
	diet	13 wk		441	mortality	Lee et al., 1978
	diet	2 yr	13.5	97 M 911 F	testicular atrophy ovarian dysfunction mortality	Ellis et al., 1979
dog	oral capsule	13 wk once/d	5	25	testicular atrophy mortality	Lee et al., 1978
	oral capsule	24 mo		10	mortality	Ellis et al., 1979

[a] No adverse developmental effects.
[b] t-DNT (technical grade, 78% 2,4-DNT, 19% 2,6-DNT, small amounts of 3,4-DNT, 2,3-DNT, and 2,5-DNT)

REFERENCES:

ATSDR. 1989. Toxicological Profile for 2,4-Dinitrotoluene and 2,6-Dinitrotoluene. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service.

Ellis, H.V., Hagensen, J.H., Hodgson, J.R., et al. 1979. Mammalian toxicity of munitions compounds. Phase III: Effects of lifetime exposure. Part I: 2,4-Dinitrotoluene. Final report No. 7. Midwest Research Institute, Kansas City, MO. Contract no. DAMD 17-74-C-4073, ADA077 692. (Cited in ATSDR 1989 and Faust 1993)

Faust, R.A. 1993. Toxicity Summary for 2,4-Dinitrotoluene. Prepared by Oak Ridge National Laboratory, Oak Ridge, TN. Prepared for U.S. Army Environmental Center. aberdeen Proving Ground, MD. 21010-5401.

Lee, C.C., Ellis, H.V., Kowalski J.J., et al. 1978. Mammalian toxicity of munitions compounds. Phase II: Effects of multiple doses. Part II: 2,4-Dinitrotoluene. Progress report No. 3. Midwest Research Institute, Kansas City, MO. Contract no. DAMD 17-74-C-4073. (Cited in ATSDR 1989 and U.S. EPA 1993)

Price, C.L., Tyl, R.W., Marks, T.A., et al. 1985. Teratologic evaluation of dinitrotoluene in the Fischer 344 rat. Fund. Appl. Toxicol. 5:948-961. (Cited in Faust 1993)

U.S. EPA. 1993. Integrated Risk Information Systems (IRIS) Online. Coversheet for 2,4-Dinitrotoluene. Cincinnati, OH: Office of Health and Environmental Assessment. Updated April, 1993.

2-NAPHTHYLAMINE						
Species	Route	Expos. Period	NOAEL mg/kg/day	LOAEL mg/kg/day	Effect/ Endpoint	Ref.
rat	gastric intubation	57 wk weekly	-	42.9[a]	bladder cancer[b], 4 out of 18 rats had neoplastic urothelium	Hicks et al., 1982
dog	oral capsule	26 wk 5 d/wk	25	-	no mortality for 3 yr	Radomski et al., 1978
	oral tablet	34 mo daily	-	18.4 M 21.3 F	bladder carcinoma[c]	Purchase et al., 1981

[a] The only dose level tested. All but one rat survived 57 weeks or longer.
[b] All rats survived 57 weeks or longer, except one rat died of respiratory disease at 21 week.
[c] No dog survived longer than 47 months.

REFERENCES:

Hicks, R.M., Wright, R., Wakefield, J. St. J. 1982. The induction of rat bladder cancer by 2-naphthylamine. Br. J. Cancer 46:646-661.

Purchase, I.F.H., Kalinowski, A.E., Ishmael, J., et al. 1981. Lifetime carcinogenicity of 1- and 2-naphthylamine in dogs. Br. J. Cancer 44:892-901.

Radomski, J.L., Krischer, C., Krischer, K.N. 1978. Histologic and histochemical preneoplastic changes in the bladder mucosa of dogs given 2-naphthylamine. J. Natl. Cancer Inst. 60:327-333.

Copper						
Species	Route	Expos. Period	NOAEL mg Cu/kg/day	LOAEL mg Cu/kg/day	Effect/ Endpoint	Ref.
Copper oxide						
chicken	diet	10 wk	33.2[a]	46.9[a]	growth	Mehring et al., 1960
Copper sulfate						
rat	diet	13 wk	66 M 68 F	-	reproductive organs	NTP, 1993
mouse	diet	1 mo+ GD 0-19	78	104 155	increased mortality developmental malformations	Lecyk, 1980
	diet	13 wk	294 M 399 F	-	reproductive organs	NTP, 1993
cattle	diet	16 mo	2.8[b]	-	reproduction	NAS, 1980
mink	diet	50 wk	-	3[c]	increased mortality	Aulerich et al., 1982
Copper acetate						
rat	diet	13 wk	-	130	increased testes weight[d]	Llewellyn et al., 1985

[a] NOAEL and LOAEL estimated from dietary levels of 403 and 570 ppm Cu (Opresko et al., 1994).
[b] NOAEL estimated from dietary level of 500 ppm $CuSo_4$.
[c] No adverse reproductive effects at 13 mg Cu/kg/day in surviving animals.
[d] "The significance of this effect in terms of reproductive toxicity is not known." (ATSDR 1990)

REFERENCES:

ATSDR. 1990. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. Toxicological Profile for Copper.

Aulerich, R.J., Ringer, R.K., Bleavins, M.R. et al. 1982 Effects of supplemental dietary copper on growth, reproductive performance and kit survival of standard dark mink and the acute toxicity of copper to mink. J. Animal Sci. 55:337-343. (Cited in ATSDR 1990)

Faust, R.A. 1992. Toxicity Summary for Copper. Prepared by Oak Ridge National Laboratory, Oak Ridge, TN. Prepared for Oak Ridge Reservation environmental Restoration Program.

Lecyk, M. 1980. Toxicity of cupric sulfate in mice embryonic development. Zool. Pol. 28:101-105. (Cited in ATSDR 1990)

Llewellyn, G.C., Floyd, E.A., Hoke, G.D., et al. 1985. Influence of dietary aflatoxin, zinc, and copper on bone size, organ weight, and body weight in hamsters and rats. Bull. Environ. Contam. Toxicol. 35:149-156. (Cited in ATSDR 1990)

Massie, HR, Aiello, V.R. 1984. Excessive intake of copper: Influence on longevity and cadmium accumulation in mice. Mech. Ageing Dev. 26:195-203. (Cited in ATSDR 1990)

Mehring, A.L. Jr., Brumbaugh, J.H., Sutherland, A.J., Titus, H.W. 1960. The tolerance of growing chickens for dietary copper. Poult. Sci. 39:713-719. (Cited in Opresko et al. 1994)

NAS. 1980. National Academy of Sciences. Mineral tolerance of domestic animals. Subcommittee on mineral toxicity in animals, Washington, DC. (Cited in NTP 1993)

NTP. 1993. NTP Technical Report on Toxicity Studies of Cupric Sulfate (CAS No. 7758-99-8). Adminstration in Drinking Water and Feed to F344/N Rats and $B6C3F_1$ Mice. NIH Publication 93-3352. July 1993. C.D. Hebert, Study Scientist.

Opresko, D.M., Sample, B.E., Sutter,II, G.W. 1994. Toxicological Benchmarks for Wildlife 1994. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-86/R1.

CHROMIUM						
Species	Route	Expos. Period	NOAEL mg Cr/kg/day	LOAEL mg Cr/kg/day	Effect/ Endpoint	Ref.
Trivalent Chromium: Chromium (III) oxide (Cr_2O_3)						
rat	diet	90 days, 5 days/wk	1400[a]	-	fertility; development	Ivankovic and Pruessman 1975
rat	diet	2 yr, 5 days/wk	1468[a]	-	survival; organ histopathology	Ivankovic and Pruessman 1975
Trivalent Chromium: Chromic chloride ($CrCl_3$)						
rat	water	1 yr	2.4[a] F 1.9[a] M	-	survival; organ histopathology	MacKenzie et al. 1958
Trivalent Chromium: Chromium sulfate [$Cr_2(SO_4)_3$]						
mouse	diet	7 wk, 7 days/wk	-	3.5	decreased spermatogenesis	Zahid et al., 1990
Trivalent Chromium: Chromium potassium sulfate [$CrK(SO_4)_2$]						
black duck	diet	10 mo	1	5	reproduction	Haseltine et al., unpubl.
Hexavalent Chromium: Potassium chromate (K_2CrO_4)						
dog	water	4 yr	0.30[a]	-		Anwar et al., 1961
rat	water	1 yr	2.4[a] F 1.9[a] M	-	survival; organ histopathology	MacKenzie et al. 1958
Hexavalent Chromium: Potassium dichromate ($K_2Cr_2O_7$)						
mouse	water	GD 1-19	-	57[b]	increased fetal resorptions and postimplantation loss	Trivedi et al. 1989
mouse	diet	7 wks, 7 days/wk	-	4.6[b]	decreased spermatogenesis	Zahid et al. 1990
rat	gavage	single dose	-	17 F 26 M	LD_{50}	Gad et al. 1986
Hexavalent Chromium: Chromium (VI) oxide (CrO_3)						
rat	gavage	single dose		25 F 29 M	LD_{50}	American Chrome and Chemical, 1989

[a] Highest dose tested.
[b] Lowest dose tested.

AN APPROACH FOR DETERMINING TOXICITY VALUES FOR DERMAL EXPOSURE.

C. B. Bast and H. T. Borges. Biomedical and Environmental Information Analysis. Health Sciences Research Division. Oak Ridge National Laboratory*, Oak Ridge, TN.

*Managed by Martin Marietta Energy Systems, Inc., for the U.S. Department of Energy under contract No. DE-AC05-84OR21400.

ABSTRACT

Oral toxicity data are available for many chemicals allowing for the calculation of Oral Reference Doses (RfD) for noncarcinogenic effects and slope factors (q_1^*) for carcinogenic effects. In contrast, dermal toxicity data for long-term exposure are not available for most chemicals which precludes calculation of dermal RfDs and slope factors. Health risks from dermal exposure to chemicals may be estimated by modification of the oral RfD or slope factor by a chemical-specific gastrointestinal absorption factor following SUPERFUND guidelines. This transforms the administered doses (oral RfDs and slope factors) into absorbed doses for comparison to intake amounts determined from dermal exposures. A computer program was developed to calculate the dermal RfD and slope factors from absorption data obtained from the published literature. When no quantitative data were available, estimates were made using structural analogs or a scheme developed to assign quantitative values to qualitative data. When quantitative data were available, the most conservative absorption factor from the species phylogenetically closest to the human was selected. The computer program uses two data bases for calculating dermal toxicity values. The first, updated quarterly, contains oral and inhalation risk values for over 600 chemicals. The second contains the absorption factor and the reference citation for over 100 chemicals. The program compares the CAS numbers of all chemicals in both data bases. When a match is found and if oral data and absorption factors are present, the program computes the dermal RfD and slope factors, prints the calculated results, the reference citations, and the source of the oral data (IRIS or HEAST). Using this methodology, RfDs ranging from 3.00E-08 to 4.00E+00 mg/kg/day and slope factors ranging from 7.89E-03 to 4.30E+02 $(mg/kg/day)^{-1}$ have been derived for over 60 chemicals.

INTRODUCTION

Oral toxicity data are available for many chemicals enabling Oral Reference Doses (RfD) for noncarcinogenic effects and slope factors (q_1^*) for carcinogenic effects to be calculated. In contrast, dermal toxicity data for long-term exposure are not available for most chemicals. This precludes the calculation of dermal RfDs and slope factors. However, the health risks from dermal exposure to chemicals can be characterized by modification of the oral RfD or slope factor by a chemical-specific gastrointestinal absorption factor. This transforms the administered doses (oral RfDs and slope factors) into absorbed doses which can then be compared to intake amounts determined from dermal exposures.

METHOD

1. Identification of Potential Acute Effects. A first step in dermal risk assessment is to review dermal toxicity of the compound and determine if it causes point of entry effects (direct skin effects). For example, strong acids and bases cause direct skin destruction, and mercury, chromium, and lead can cause skin irritation at relatively low concentrations. Even if the amount of chemical involved in dermal exposure is small compared to the amount inhaled or ingested, dermal toxicity may be important if acute skin effects exist. Also, when applying the following risk equations, it is important to evaluate the risk value obtained in reference to the contribution of contact site toxicity.

2. Identification of Gastrointestinal Absorption Factors. Absorption data were obtained through on-line literature searches of National Library of Medicine (NLM) databases and from hardcopy sources. Secondary sources such as monographs, surveys, review articles, and criteria documents were used to obtain gastrointestinal absorption data when possible. However, if no absorption data were present in the secondary sources or if the absorption data were not clearly presented, primary publications were consulted.

Gastrointestinal (GI) absorption values calculated and reported in the literature were utilized when the methods employed appeared to be scientifically sound. In cases where no absorption factors were reported or where the factors appeared to be derived by inappropriate methods, attempts were made to estimate absorption factors from the published absorption and excretion data. In these instances, absorption was estimated by adding amounts of compound recovered in all reported organs (excluding the luminal contents of the stomach and intestines) at necropsy and/or from amounts measured from sampling of plasma, saliva, urine, and breath. In many cases it was possible to estimate only a lower limit of absorption since it could not be determined if compound detected in the feces was actually absorbed. In these cases, absorption is reported as "greater than or equal to" a given value.

In some cases qualitative descriptions of gastrointestinal absorption, such as "readily absorbed" or "poorly absorbed" are available. When comparing qualitative and quantitative GI absorption data, the terms "rare, little, sparse, and low" tend to refer to absorptions between 1-20%, "readily and rapidly" to absorptions between 20-90%, and "well and almost complete" between 70-100%. Because terms such as readily and rapidly may refer to rate rather than amount of absorption, it is difficult to devise a qualitative absorption ranking system based on the terms most commonly found in the literature. The following system is suggested when no quantitative data exist but qualitative data are present:

Negligibly Absorbed:	<1%
Poorly Absorbed:	1-20%
Moderately Absorbed:	21-50%
Well Absorbed:	51-80%
Very Well Absorbed:	>80%

If no quantitative or qualitative data were available for specific chemicals, an attempt was made to estimate absorption factors by structural analogy.

3. Selection of Gastrointestinal Absorption Factors for Use in Dermal Risk Assessment. The following scheme was developed to select GI absorption factors for use in dermal risk assessment:

For chemicals with quantitative absorption data:

1) Select absorption data from the species whose skin most closely mimics human skin (U.S. EPA, 1992).

Human > Non-human Primate, Pig > Rat, Guinea Pig > Mouse, Rabbit

2) Select the most conservative absorption value (lowest percentage absorption) from the appropriate species. (When the only value available was expressed as "greater than or equal to" a given absorption, the value itself was selected.)

For chemicals with only qualitative absorption data:

1) Utilize the qualitative system previously presented.

Subjectively select the most appropriate absorption category, and select the lower limit of the range as the absorption factor.

4. Conversion from Administered to Absorbed Dose. GI absorption factors for 135 chemicals of interest at DOE's Oak Ridge Reservation were identified in the literature and placed into a dermal risk database. The CAS numbers of these chemicals were compared electronically with the CAS numbers of a database containing the RfD and Slope Factors of over 600 hundred chemicals. When an exact match was found, the RfD and Slope Factor was inserted into the dermal risk database and converted to toxicity values based on absorbed dosed for dermal exposure as follows (U.S. EPA, 1992; U.S. EPA, 1989):

$$RfD_{absorbed} = RfD_{administered} \times ABS_{GI}$$

$$q_1{}^{*}{}_{absorbed} = q_1{}^{*}{}_{administered} \, / \, ABS_{GI}$$

RESULTS

Using this methodology, RfDs ranging from 3.00E-08 to 4.00E+00 mg/kg/day and slope factors ranging from 7.89E-03 to 4.30E+02 $(mg/kg/day)^{-1}$ have been derived for over 60 chemicals. The computer-generated table provides a consistent mathematical method for calculating dermal toxicity values and is presented below.

REFERENCES*

U.S. EPA. 1989. Risk Assessment Guidance for Superfund. Volume I. Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response, Washington, DC. December, 1989. EPA/540/1-89/002.

U.S. EPA. 1992. Dermal Exposure Assessment: Principles and Applications. Interim Report. Office of Health and Environmental Assessment. Washington, DC. January, 1992. EPA/600/6-91/011B.

**References from which gastrointestinal absorption factors were obtained are listed at the end of the computer-generated table.*

DERMAL RISK VALUES DERIVED BY CALCULATION FROM GASTROINTESTINAL (GI) ABSORPTION DATA IN ALPHABETICAL ORDER

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day)		Oral Slope Factor $(mg/kg/day)^{-1}$	Dermal RfD (mg/kg/day)		Dermal Slope Factor $(mg/kg/day)^{-1}$
				Chronic	Subchronic		Chronic	Subchronic	
Acenaphthene	000083-32-9	31	2	6.00E-02 [b]	6.00E-01 [c]	NA	1.86E-02	1.86E-01	NA
Acenaphthylene	000208-96-8	31	2	NA	NA	NA	NA	NA	NA
Acetone	000067-64-1	83	3	1.00E-01 [b]	1.00E+00 [c]	NA	8.30E-02	8.30E-01	NA
Aluminum	007429-90-5	10	4,5	NA	NA	NA	NA	NA	NA
Anthracene	000120-12-7	76	6	3.00E-01 [b]	3.00E+00 [c]	NA	2.28E-01	2.28E+00	NA
Antimony (metallic)	007440-36-0	2.0	7	4.00E-04 [b]	4.00E-04 [c]	NA	8.00E-06	8.00E-06	NA
Arsenic Salts	NA	80	26	NA	NA	NA	NA	NA	NA
Arsenic, Inorganic	007440-38-2	41	8	3.00E-04 [b]	3.00E-04 [c]	NA	1.23E-04	1.23E-04	NA
Barium	007440-39-3	7.0	9	7.00E-02 [b]	7.00E-02 [c]	NA	4.90E-03	4.90E-03	NA
Benz[a]anthracene	000056-55-3	31	2	NA	NA	NA	NA	NA	NA
Benzene	000071-43-2	97	10	NA	NA	2.90E-02 [b]	NA	NA	2.99E-02
Benzo[a]pyrene	000050-32-8	31	2	NA	NA	7.30E+00 [b]	NA	NA	2.35E+01
Benzo[b]fluoranthene	000205-99-2	31	2	NA	NA	NA	NA	NA	NA
Benzo[g,h,i]perylene	000191-24-2	31	2	NA	NA	NA	NA	NA	NA
Benzo[k]fluoranthene	000207-08-9	31	2	NA	NA	NA	NA	NA	NA
Beryllium	007440-41-7	1.0	13, 14	5.00E-03 [b]	5.00E-03 [c]	4.30E+00 [b]	5.00E-05	5.00E-05	4.30E+02
Bis(2-ethylhexyl)phthalate	000117-81-7	19	15	2.00E-02 [b]	2.00E-02	1.40E-02 [b]	3.80E-03	3.80E-03	7.37E-02
Butyl Benzyl Phthlate	000085-68-7	61	66	2.00E-01 [b]	2.00E+00 [c]	NA	1.22E-01	1.22E+00	NA
Cadmium (Diet)	007440-43-9	1.0	16, 17, 18, 19	1.00E-03 [b]	NA	NA	1.00E-05	NA	NA
Cadmium (Water)	007440-43-9	1.0	16, 17, 18, 19	5.00E-04 [b]	NA	NA	5.00E-06	NA	NA
Carbon Tetrachloride	000056-23-5	65	21	7.00E-04 [b]	7.00E-03	1.30E-01 [b]	4.55E-04	4.55E-03	2.00E-01
Chloride	016887-00-6	100	45	NA	NA	NA	NA	NA	NA
Chlorobenzene	000108-90-7	31	23	2.00E-02 [b]	2.00E-01	NA	6.20E-03	6.20E-02	NA
Chloroform	000067-66-3	20	24	1.00E-02 [b]	1.00E-02	6.10E-03 [b]	2.00E-03	2.00E-03	3.05E-02
Chromium (III) (Insoluble Salts)	016065-83-1	0.50	65	1.00E+00 [b]	1.00E+00 [c]	NA	5.00E-03	5.00E-03	NA
Chromium (VI)	018540-29-9	2.0	25	5.00E-03 [b]	2.00E-02	NA	1.00E-04	4.00E-04	NA

[illegible] Values were calculated using interim U.S. EPA methodology. However, these values have not been through the U.S. EPA approval process.

DERMAL RISK VALUES DERIVED BY CALCULATION FROM GASTROINTESTINAL (GI) ABSORPTION DATA IN ALPHABETICAL ORDER

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day) Chronic	Oral RfD (mg/kg/day) Subchronic	Oral Slope Factor $(mg/kg/day)^{-1}$	Dermal RfD (mg/kg/day) Chronic	Dermal RfD (mg/kg/day) Subchronic	Dermal Slope Factor $(mg/kg/day)^{-1}$
Chromium Salts	NA	2.0	65	NA	NA	NA	NA	NA	NA
Chrysene	000218-01-9	31	2	NA	NA	NA	NA	NA	NA
Copper	007440-50-8	30	27	NA	NA	NA	NA	NA	NA
Cyanide (CN-)	000057-12-5	17	37	2.00E-02 [b]	2.00E-02 [c]	NA	3.40E-03	3.40E-03	NA
DDD	000072-54-8	70	28	NA	NA	2.40E-01 [b]	NA	NA	3.43E-01
DDE	000072-55-9	70	28	NA	NA	3.40E-01 [b]	NA	NA	4.86E-01
DDT	000050-29-3	70	28	5.00E-04 [b]	5.00E-04 [c]	3.40E-01 [b]	3.50E-04	3.50E-04	4.86E-01
Dibenz[a,h]anthracene	000053-70-3	31	2	NA	NA	NA	NA	NA	NA
Dibutyl Phthalate	000084-74-2	100	29	1.00E-01 [b]	1.00E+00 [c]	NA	1.00E-01	NA	NA
Dichlorodifluoromethane	000075-71-8	23	12	2.00E-01 [c]	9.00E-01 [c]	NA	4.60E-02	2.07E-01	NA
Dichloroethane, 1,1-	000075-34-3	100	68	1.00E-01 [c]	1.00E+00 [c]	NA	1.00E-01	NA	NA
Dichloroethane, 1,2-	000107-06-2	100	30	NA	NA	9.10E-02 [b]	NA	NA	9.10E-02
Dichloroethylene, 1,1-	000075-35-4	100	31	9.00E-03 [b]	9.00E-03 [c]	6.00E-01 [b]	9.00E-03	9.00E-03	6.00E-01
Dichloroethylene, 1,2-cis-	000156-59-2	100	53	1.00E-02 [c]	1.00E-01 [c]	NA	1.00E-02	1.00E-01	NA
Dichloroethylene, 1,2-trans-	000156-60-5	100	53	2.00E-02 [b]	2.00E-01 [c]	NA	2.00E-02	2.00E-01	NA
Diethyl Phthalate	000084-66-2	90	67	8.00E-01 [b]	8.00E+00 [c]	NA	7.20E-01	7.20E+00	NA
Dimethylphthalate	000131-11-3	90	67	NA	NA	NA	NA	NA	NA
Dinitrobenzene, 1,3-	000099-65-0	65	32	1.00E-04 [b]	1.00E-03 [c]	NA	6.50E-05	6.50E-04	NA
Dinitrophenol, 2,4-	000051-28-5	100	35	2.00E-03 [b]	2.00E-03 [c]	NA	2.00E-03	2.00E-03	NA
Dinitrotoluene, 2,4-	000121-14-2	85	33	2.00E-03 [b]	2.00E-03 [c]	6.80E-01 [b,d]	1.70E-03	1.70E-03	8.00E-01
Dinitrotoluene, 2,6-	000606-20-2	85	33	1.00E-03 [c]	1.00E-02 [c]	6.80E-01 [b,d]	8.50E-04	8.50E-03	8.00E-01
Dinitrotoluene, 2-Amino-4,6-	035572-78-2	50 [e]	69	NA	NA	NA	NA	NA	NA
Ethylbenzene	000100-41-4	97	10	1.00E-01 [b]	NA	NA	9.70E-02	NA	NA
Fluoranthene	000206-44-0	31	2	4.00E-02 [b]	4.00E-01 [c]	NA	1.24E-02	1.24E-01	NA
Fluoride	007782-41-4	97	34	6.00E-02 [b]	6.00E-02 [c]	NA	5.82E-02	5.82E-02	NA
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetra)	002691-41-0	15	11	5.00E-02 [b]	NA	NA	7.50E-03	NA	NA

The Dermal Risk Values were calculated using interim U.S. EPA methodology. However, these values have not been through the U.S. EPA approval process.

DERMAL RISK VALUES DERIVED BY CALCULATION
FROM GASTROINTESTINAL (GI) ABSORPTION DATA IN ALPHABETICAL ORDER

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day) Chronic	Oral RfD (mg/kg/day) Subchronic	Oral Slope Factor $(mg/kg/day)^{-1}$	Dermal RfD (mg/kg/day) Chronic	Dermal RfD (mg/kg/day) Subchronic	Dermal Slope Factor $(mg/kg/day)^{-1}$
Indeno[1,2,3-cd]pyrene	000193-39-5	31	2	NA	NA	NA	NA	NA	NA
Lead And Compounds	007439-92-1	15	26	NA	NA	NA	NA	NA	NA
Manganese (Diet)	007439-96-5	4.0	38	1.40E-01 [b]	1.40E-01 [c]	NA	5.60E-03	5.60E-03	NA
Manganese (Water)	007439-96-5	4.0	38	5.00E-03 [b]	5.00E-03 [c]	NA	2.00E-04	2.00E-04	NA
Mercury, Inorganic	007439-97-6	0.01	26, 39	3.00E-04 [c]	3.00E-04 [c]	NA	3.00E-08	3.00E-08	NA
Mercury, Inorganic Salts	007439-97-6	7.0	26	3.00E-04	3.00E-04	NA	2.10E-05	2.10E-05	NA
Methyl Isobutyl Ketone (Isopropylacetone)	000108-10-1	80	1				NA	NA	NA
Methylene Chloride	000075-09-2	95	41	6.00E-02 [b]	6.00E-02 [c]	7.50E-03 [b]	5.70E-02	5.70E-02	7.89E-03
Molybdenum	007439-98-7	38	42	5.00E-03 [b]	5.00E-03 [c]	NA	1.90E-03	1.90E-03	NA
Naphthalene	000091-20-3	80	43	NA	NA	NA	NA	NA	NA
Nickel Soluble Salts	007440-02-0	27	44	2.00E-02 [b]	2.00E-02 [c]	NA	5.40E-03	5.40E-03	NA
Nitrate	014797-55-8	50	40	1.60E+00 [b]	NA	NA	8.00E-01	NA	NA
Nitrite	014797-65-0	50	40	1.00E-01 [b]	1.00E-01 [c]	NA	5.00E-02	5.00E-02	NA
Nitrobenzene	000098-95-3	97	10	5.00E-04 [b]	5.00E-03 [c]	NA	4.85E-04	4.85E-03	NA
Nitrotoluene, 4-Amino-2-	000119-32-4	50 [e]	69	NA	NA	NA	NA	NA	NA
Octyl Phthalate, di-N-	000117-84-0	90	67	2.00E-02 [c]	2.00E-02 [c]	NA	1.80E-02	1.80E-02	NA
Pentachlorophenol	000087-86-5	100	64	3.00E-02 [b]	3.00E-02 [c]	1.20E-01 [b]	3.00E-02	3.00E-02	1.20E-01
Phenanthrene	000085-01-8	73	2	NA	NA	NA	NA	NA	NA
Phenol	000108-95-2	90	12	6.00E-01 [b]	6.00E-01 [c]	NA	5.40E-01	5.40E-01	NA
Pyrene	000129-00-0	31	2	3.00E-02 [b]	3.00E-01 [c]	NA	9.30E-03	9.30E-02	NA
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	000121-82-4	100	60	3.00E-03 [b]	3.00E-03 [c]	1.10E-01 [b]	3.00E-03	3.00E-03	1.10E-01
Radium 226	013982-63-3	20	22	NA	NA	NA	NA	NA	NA
Radium 228	015262-20-1	20	22	NA	NA	NA	NA	NA	NA
Selenium	007782-49-2	44	47	5.00E-03 [b]	5.00E-03 [c]	NA	2.20E-03	2.20E-03	NA
Silver	007440-22-4	18	49	5.00E-03 [b]	5.00E-03 [c]	NA	9.00E-04	9.00E-04	NA
Sodium	007440-23-5	100	45	NA	NA	NA	NA	NA	NA

The Dermal Risk Values were calculated using interim U.S. EPA methodology. However, these values have not been through the U.S. EPA approval process.

DERMAL RISK VALUES DERIVED BY CALCULATION FROM GASTROINTESTINAL (GI) ABSORPTION DATA IN ALPHABETICAL ORDER

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day) Chronic	Oral RfD (mg/kg/day) Subchronic	Oral Slope Factor (mg/kg/day)$^{-1}$	Dermal RfD (mg/kg/day) Chronic	Dermal RfD (mg/kg/day) Subchronic	Dermal Slope Factor (mg/kg/day)$^{-1}$
Strontium 90	010098-97-2	16	46	NA	NA	NA	NA	NA	NA
Sulfate	014808-79-8	20	50	NA	NA	NA	NA	NA	NA
TCDD, 2,3,7,8-	001746-01-6	50	48	NA	NA	1.50E+05	NA	NA	3.00E+05
Tetrachloroethane, 1,1,2,2-	000079-34-5	70	51	NA	NA	2.00E-01 [b]	NA	NA	2.86E-01
Tetrachloroethylene	000127-18-4	100	63	1.00E-02 [b]	1.00E-01 [c]	NA	1.00E-02	1.00E-01	NA
Tetryl (Trinitrophenylmethylnitramine)	000479-45-8	50 [e]	69	1.00E-02 [c]	1.00E-01 [c]	NA	5.00E-03	5.00E-02	NA
Thallium	007440-28-0	15	52	NA	NA	NA	NA	NA	NA
Toluene	000108-88-3	80	54	2.00E-01 [b]	2.00E+00 [c]	NA	1.60E-01	1.60E+00	NA
Toluidine, 5-Nitro-o-	000099-55-8	50 [e]	69	NA	NA	3.30E-02	NA	NA	6.60E-02
Trichlorobenzene, 1,2,4-	000120-82-1	97	36	1.00E-02 [b]	1.00E-02 [c]	NA	9.70E-03	9.70E-03	NA
Trichloroethane, 1,1,1-	000071-55-6	90	55	NA	NA	NA	NA	NA	NA
Trichloroethane, 1,1,2-	000079-00-5	81	56	4.00E-03 [b]	4.00E-02 [c]	5.70E-02 [b]	3.24E-03	3.24E-02	7.04E-02
Trichloroethylene	000079-01-6	15	57	NA	NA	NA	NA	NA	NA
Trinitrobenzene, 1,3,5-	000099-35-4	65	32	5.00E-05 [b]	5.00E-04 [c]	NA	3.25E-05	3.25E-04	NA
Trinitrotoluene, 2,4,6-	000118-96-7	60	20	5.00E-04 [b]	5.00E-04 [c]	3.00E-02 [b]	3.00E-04	3.00E-04	5.00E-02
Vanadium, Metallic	007440-62-2	1.0	58, 59	7.00E-03 [c]	7.00E-03 [c]	NA	7.00E-05	7.00E-05	NA
Vinyl Chloride	000075-01-4	100	70	NA	NA	1.90E+00	NA	NA	1.90E+00
Xylene, Mixture	001330-20-7	92	61	2.00E+00 [b]	NA	NA	1.84E+00	NA	NA
Zinc (Metallic)	007440-66-6	20	62	3.00E-01 [b]	3.00E-01 [c]	NA	6.00E-02	6.00E-02	NA

[a] GI absoprtion factors obtained from literature by BEIA staff
[b] Source: Integrated Risk Information System (IRIS)
[c] Source: Health and Environmental Affects Summary Table (HEAST) 1993
[d] Listed as "Dinitrotoluene mixture, 2,4-/2,6-" in IRIS. The value is based on a study using technical grade DNT.
[e] Interim U.S. EPA Region IV default value

The Dermal Risk Values were calculated using interim U.S. EPA methodology. However, these values have not been through the U.S. EPA approval process.

GI ABSORPTION REFERENCES

Reference Number	Reference
1	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for 2-Butanone. ATSDR/U.S. Public Health Service.
2	Rahman, A., J.A. Barrowman and A. Rahimtula. 1986. The influence of bile on the bioavailability of polynuclear aromatic hydrocarbons from the rat insestine. Can. J. Physiol. Pharmacol. 64:1214-1218
3	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for Acetone. ATSDR/U.S. Public Health Service
4	Venugopal, B. and T.D. Luckey. 1978. Metal Toxicity in Mammals-2. Chemical Toxicity of Metals and Metalloids. Plenum Press. pp. 104-112
5	Kortus, J. 1967. The carbohydrate metabolism accompanying intoxication by aluminum salts in the rat. Experientia. 23: 912-913
6	Rahman, A., J.A. Barrowman and A. Rahimtula. 1986. The influence of bile on the bioavailability of polynuclear aromatic hydrocarbons from the rat intestine. Can. J. Physiol. Pharmacol. 64:1214-1218
7	Gerber, G.B., J. Maes and B. Eykens. 1982. Transfer of antimony and arsenic to the developing organism. Arch. Toxicol. 49: 159-168
8	Bettley, F.R.; O'Shea, J.A. 1975. The absorption of arsenic and its relation to carcinoma. Br. J. Dermatology. 92:563. (Cited in Hindmarsh and McCurdy, 1986)
9	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for Barium. ATSDR/U.S. Public Health Service
10	Sabourin, P.J., B.T. Chen, G. Lucier, et al. 1987. Effects of dose on the absorption and excretion of [14C]Benzene administered orally or by inhalation in rats and mice. Toxicol. Appl. Pharmacol. 87:325-336
11	ATSDR (Agency for Toxic Substances and Disease Registry). 1994. Toxicological Profile for HMX (Draft). ATSDR/U.S. Public Health Service
12	HSDB (Hazardous Substances Data Bank). 1994. MEDLARS Online Information Retrieval System, National Library of Medicine. Retrieved March, 1994
13	Furchner, J.E., C.R. Richmond and J.E. London. 1973. Comparative metabolism of radionuclides in mammals: VII. Retention of beryllium in the mouse, rat, monkey and dog. Health Phys. 24: 292-300
14	Reeves, A.L. 1965. The absorption of beryllium from the gastrointestinal tract. Arch. Environ. Health 11:209-214
15	Teirlynck, O.A. and J. Belpaire. 1985. Disposition of orally administered di(2-ethylhexyl)phthalate and mono(2-ethylhexyl)phthalate in the rat. Arch. toxicol. 57(4):226-230
16	Foulkes, E.C. 1986. Absorption of cadmium. In: Foulkes, E.C., ed. Handbook of Experimental Pharmacology. Vol. 80, Springer-Verlag, Berlin, pp. 75-100
17	Nordberg, G.F., T. Kjellstrom and M. Nordberg. 1985. Kinetics and metabolism. In: Friberg, L., C.G. Elinder, T. Kjellstrom and G.F. Nordberg, eds. Cadmium and Health: A toxicological and epidemiological appraisal. Vol. 1. Exposure, Dose, and Metabolism. L. Friberg, C.G. Elinder, T. Kjellstrom, and G.F. Nordberg, eds. CRC Press, Boca Raton, FL, pp. 103-178.
18	McLellan, J.S., P.R. Flanagan, M.J. Chamberlain and L.S. Valberg. 1978. Measurement of dietary cadmium absorption in humans. J. Toxicol. Environ. Health 4:131-138
19	Shaikh, Z.A. and J.C. Smith. 1980. Metabolism of orally ingested cadmium in humans. In: Mechanisms of Toxicity and Hazard Evaluation, B. Holmstead, et al., eds. Elsevier/North Holland, Amsterdam. pp. 569-574
20	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for 2,4,6-Trinitrotoluene (Draft). ATSDR/U.S. Public Health Service
21	U.S. EPA. 1989. Updated Health Effects Assessment for Carbon Tetrachloride. Prepared for the Office Emergency and Remedial Response, Washington, DC. Environmental Criteria and Assessment Office, Cincinnati, OH

GI ABSORPTION REFERENCES

Reference Number	Reference
22	ATSDR (Agency for Toxic Substances and Disease Registry). 1990. Toxicological Profile for Radium. ATSDR/U.S. Public Health Service
23	ATSDR (Agency for Toxic Substances and Disease Registry). 1990. Toxicological Profile for Chlorobenzene. ATSDR/U.S. Public Health Service
24	Brown, D.M., P.F. Langely, D. Smith, et al. 1974. Metabolism of Chloroform. I. The metabolism of [14C]-chloroform by different species. Xenobiotica 4:151-163
25	U.S. EPA. 1984. Health Effects Assessment for Chromium. Final Report. Environmental Criteria and Assessment Office. Research Triangle Park, NC. EPA-600/8-83-014F. PB85-115905
26	Goyer, R.A. 1991. Toxic Effects of Metals. In: Casarett and Doull's Toxicology: The Basic Science of Poisons, fourth edition. M. O. Ammdur, J. Doull, and C.D. Klaassen, eds. pp. 623-680
27	Venugopal, B. and T.D. Luckey. 1978. Metal Toxicity in Mammals - 2. Chemical Toxicity of Metals and Metalloids. Plenum Press. pp. 104-112.
28	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for p,p'-DDT, DDE, DDD. ATSDR/U.S. Public Health Service
29	ATSDR (Agency for Toxic Substances and Disease Registry). 1990. Toxicological Profile for Di-n-Butylphthalate. ATSDR/U.S. Public Health Service
30	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for 1,2-Dichloroethane. ATSDR/U.S. Public Health Service
31	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for 1,1-Dichloroethene. ATSDR/U.S. Public Health Service
32	Parke, D. 1961. Studies in detoxification. V. The metabolism of m-dinitro[14C]benzene in the rabbit. Biochem. J. 78:262-271
33	U.S. EPA. 1986. Health and Environmental Effects Profile for Dinitrotoluene. Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office. Cincinnati, OH. ECAO- CIN-P183
34	ATSDR (Agency for Toxic Substances and Disease Registry). 1991. Toxicological Profile for Fluoride, Hydrogen Fluoride, and Fluorine. ATSDR/U.S. Public Health Service
35	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Heptachlor/Heptachlor Epoxide. ATSDR/U.S. Public Health Service
36	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for 1,4-Dichlorobenzene. ATSDR/U.S. Public Health Service
37	U.S. EPA. 1984. Health Effects Assessment for Cyanides. Prepared by the Environmental Criteria and Assessment Office, Cincinnati, OH for the Emergency and Remedial Response Office, Washington, DC. EPA/540/1-86-011
38	U.S. EPA. 1990. Integrated Risk Information System (IRIS). Health Risk Assessment for Manganese. On line. (Verification date 6/21/90). Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH
39	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for Mercury. ATSDR/U.S. Public Health Service
40	Green, L.C., et al. 1981. Nitrate biosynthesis in man. PNAS 78:7764-7768.
41	Angelo, M.J., A.B. Pritchard, D.R. Hawkins, et al. 1986. The pharmacokinetics of dichloromethane. I. Disposition in B6C3F1 mice following intravenous and oral administration. Food Chem. Toxicol. 24: 965-974
42	Friberg, L.; Lener, J. 1986. Molybenum. In: Handbook on the Toxicology of Metals. 2nd ed. L. Friberg, G.F. Nordberg and V.B. Vouk, eds. Elsevier/North-Holland Biomedical Press, New York. pp. 446-461
43	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Naphthalene. ATSDR/U.S. Public Health Service

GI ABSORPTION REFERENCES

Reference Number	Reference
44	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Nickel. ATSDR/U.S. Public Health Service
45	Tietz, N.W., Pruden, E.L., and Siggaard-Anderson, O. Electrolytes, Blood Gasses, and Acid-base Balance. In: Textbook of Clinical Chemistry. N.W. Tietz, Ed., W.B. Saunders & Co.
46	Beliles, R.P., 1994. The Metals. In: Patty's Industrial Hygiene and Toxicology. 4th ed. Vol. II. Part C. Toxicology. G.D. Clayton and F.E. Clayton Ed., John Wiley & Sons.
47	Medinsky, M.A., R.G. Cuddihy, R.O. McClellan. 1981. Systemic absorption of selenious acid and elemental selenium aerosols in rats. J. of Toxicol. Environ. Health 8:917-928.
48	Benyz, T.J. and Leber, A.P., 1994. Halogenated Cyclic Hydrocarbons. In: Patty's Industrial Hygiene and Toxicology. 4th ed. Vol. II. Part C. Toxicology. G.D. Clayton and F.E. Clayton Ed., John Wiley & Sons.
49	East, B.W., K. Boddy, E.D. Williams, et al. 1980. Silver retention, total body silver and tissue silver concentrations in argyria associated with exposure to an anti-smoking remedy containing silver acetate. Clin. Exp. Dermatol. 5:305-311
50	World Health Organization (WHO). 1984. Guidelines for Drinking Water Quality, Vol. 2. Health Criteria and Other Supporting Information
51	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for 1,1,2,2-Tetrachloroethane. ATSDR/U.S. Public Health Service
52	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for Thallium. ATSDR/U.S. Public Health Service
53	U.S. EPA. 1980. Ambient Water Quality Criteria for Dichlorothylenes. Environmental Criteria and Assessment Office, Cincinnati, OH. EPA 440/5-80-041. NTIS PB 81-117525.
54	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for Toluene. ATSDR/U.S. Public Health Service
55	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for 1,1,1-Trichloroethane. ATSDR/U.S. Public Health Service
56	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for 1,1,2-Trichloroethane. ATSDR/U.S. Public Health Service
57	Daniel, J.W. 1963. The metabolism of 36Cl-labelled trichloroethylene and tetrachlorethylene in the rat. Biochem. Pharmacol. 12:795-802
58	Curran, G.L. and R.E. Burch. 1967. Biological and health effects of Vanadium. In: D.D. Hemphill Ed. Proceedings of the Conference on Trace Substances in Environmental Health. University of Missouri, Columbia, MO, pp. 96-104
59	ICRP (International Commission on Radiological Protection). 1960. Report of Committee II on Permissible Dose for Internal Radiation. Recommendations of the International Commission on Radiological Protection. ICRP Publ. No. 2. Pergamon Press, Oxford, England, p. 163.
60	U.S. EPA. 1989. Health and Environmental Effects Document for RDX Cyclonite. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Cincinnati, OH. ECAO-CIN-G078.
61	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Total Xylenes. ATSDR/U.S. Public Health Service
62	U.S. EPA. 1984. Health Effects Assessment for Zinc and Compounds. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC. EPA/540/1-86-048
63	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Tetrachloroethylene. ATSDR/U.S. Public Health Service.
64	ATSDR (Agency for Toxic Substances and Disease Registry). 1994. Toxicological Profile for Pentachlorophenol. ATSDR/U.S. Public Health Service.
65	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Chromium. ATSDR/U.S. Public Health Service.

GI ABSORPTION REFERENCES

Reference Number	Reference
66	U.S. EPA. 1989. Health and Environmental Effects Document for Butyl benzyl phthalate. Prepared for the Office of Solid Waste and Emergency Response, Washington, DC by the Environmental Criteria and Assessment Office, Cincinnati, OH. ECAO-CIN-G081.
67	U.S. EPA. 1987. Health and Enviornmental Effects Profile for Phthalic acid alkyl, aryl, and alkyl/aryl esters. Prepared for the Office of Solid Waste and Emergency Response, Washington, DC, by the Environmental Criteria and Assessment Office, Cincinnati, OH. ECAO-CIN-P188.
68	U.S. EPA. 1985. Health and Enviornmental Effects Document for Dichloroethanes. Prepared for the Office of Solid Waste and Emergency Response, Washington, DC, by the Environmental Criteria and Assessment Office, Cincinnati, OH. ECAO-CIN-P139.
69	U.S. EPA. Undated. Default Oral Absorption Values for Dermal Reference Dose Adjustment. Supplemental Guidance to RAGS: Region IV Bulletin.
70	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Vinyl Chloride. ATSDR/U.S. Public Health Service.

DERMAL RISK VALUES DERIVED BY CALCULATION FROM GASTROINTESTINAL (GI) ABSORPTION DATA IN ALPHABETICAL ORDER

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day)		Oral Slope Factor $(mg/kg/day)^{-1}$	Dermal RfD (mg/kg/day)		Dermal Slope Factor $(mg/kg/day)^{-1}$
				Chronic	Subchronic		Chronic	Subchronic	
Acenaphthene	000083-32-9	31	2	6.00E-02[b]	6.00E-01[c]	NA	1.86E-02	1.86E-01	NA
Acenaphthylene	000208-96-8	31	2	NA	NA	NA	NA	NA	NA
Acetone	000067-64-1	83	3	1.00E-01[b]	1.00E+00[c]	NA	8.30E-02	8.30E-01	NA
Aldrin	000309-00-2	50	65	3.00E-05[b]	3.00E-05[c]	1.70E+01[b]	1.50E-05	1.50E-05	3.40E+01
Aluminum	007429-90-5	10	4,5	NA	NA	NA	NA	NA	NA
Anthracene	000120-12-7	76	6	3.00E-01[b]	3.00E+00[c]	NA	2.28E-01	2.28E+00	NA
Antimony (metallic)	007440-36-0	2.0	7	4.00E-04[b]	4.00E-04[c]	NA	8.00E-06	8.00E-06	NA
Aroclor 1016	012674-11-2	90	46	7.00E-05[b]	NA	NA	6.30E-05	NA	NA
Aroclor 1254	011097-69-1	90	46	2.00E-05[b]	5.00E-05[c]	NA	1.80E-05	4.50E-05	NA
Aroclor 1260	011096-82-5	90	46	NA	NA	NA	NA	NA	NA
Arsenic Salts	NA	80	26	NA	NA	NA	NA	NA	NA
Arsenic, Inorganic	007440-38-2	41	8	3.00E-04[b]	3.00E-04[c]	NA	1.23E-04	1.23E-04	NA
Barium	007440-39-3	7.0	9	7.00E-02[b]	7.00E-02[c]	NA	4.90E-03	4.90E-03	NA
Benz[a]anthracene	000056-55-3	31	2	NA	NA	NA	NA	NA	NA
Benzene	000071-43-2	97	10	NA	NA	2.90E-02[b]	NA	NA	2.99E-02
Benzene Hexachloride	NA	97	10	NA	NA	NA	NA	NA	NA
Benzene, Ethyldimethyl	NA	97	10	NA	NA	NA	NA	NA	NA
Benzene, Ethylmethyl	NA	97	10	NA	NA	NA	NA	NA	NA
Benzene, Methylpropenyl	NA	97	10	NA	NA	NA	NA	NA	NA
Benzene, Methylpropyl	NA	97	10	NA	NA	NA	NA	NA	NA
Benzene, Trimethyl	025551-13-7	97	10	NA	NA	NA	NA	NA	NA
Benzidine	000092-87-5	80	11	3.00E-03[b]	3.00E-03[c]	2.30E+02[b]	2.40E-03	2.40E-03	2.88E+02
Benzo[a]pyrene	000050-32-8	31	2	NA	NA	7.30E+00[b]	NA	NA	2.35E+01
Benzo[b]fluoranthene	000205-99-2	31	2	NA	NA	NA	NA	NA	NA
Benzo[g,h,i]perylene	000191-24-2	31	2	NA	NA	NA	NA	NA	NA
Benzo[k]fluoranthene	000207-08-9	31	2	NA	NA	NA	NA	NA	NA

The Dermal Risk Values were calculated using interim U.S. EPA methodology. However, these values have not been through the U.S. EPA approval process.

DERMAL RISK VALUES DERIVED BY CALCULATION FROM GASTROINTESTINAL (GI) ABSORPTION DATA IN ALPHABETICAL ORDER

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day)		Oral Slope Factor $(mg/kg/day)^{-1}$	Dermal RfD (mg/kg/day)		Dermal Slope Factor $(mg/kg/day)^{-1}$
				Chronic	Subchronic		Chronic	Subchronic	
Benzoic Acid	000065-85-0	100	12	4.00E+00 [b]	4.00E+00 [c]	NA	4.00E+00	4.00E+00	NA
Benzyl Alcohol	000100-51-6	66	12	3.00E-01 [c]	1.00E+00 [c]	NA	1.98E-01	6.60E-01	NA
Beryllium	007440-41-7	1.0	13, 14	5.00E-03 [b]	5.00E-03 [c]	4.30E+00 [b]	5.00E-05	5.00E-05	4.30E+02
Bis(2-ethylhexyl)phthalate	000117-81-7	19	15	2.00E-02 [b]	2.00E-02	1.40E-02 [b]	3.80E-03	3.80E-03	7.37E-02
Boron And Borates Only	007440-42-8	90	75	9.00E-02 [b]	9.00E-02 [c]	NA	8.10E-02	8.10E-02	NA
Bromodichloromethane	000075-27-4	98	67	2.00E-02 [b]	2.00E-02 [c]	6.20E-02 [b]	1.96E-02	1.96E-02	6.33E-02
Bromoform	000075-25-2	60	69	2.00E-02 [b]	2.00E-01 [c]	7.90E-03 [b]	1.20E-02	1.20E-01	1.32E-02
Butanone-2, 4-chloro-4,4-difluoro	NA	80	1	NA	NA	NA	NA	NA	NA
Butyl Benzyl Phthlate	000085-68-7	61	78	2.00E-01 [b]	2.00E+00 [c]	NA	1.22E-01	1.22E+00	NA
Cadmium (Diet)	007440-43-9	1.0	16, 17, 18, 19	1.00E-03 [b]	NA	NA	1.00E-05	NA	NA
Cadmium (Water)	007440-43-9	1.0	16, 17, 18, 19	5.00E-04 [b]	NA	NA	5.00E-06	NA	NA
Carbazole	000086-74-8	70	76	NA	NA	2.00E-02	NA	NA	2.86E-02
Carbon Disulfide	000075-15-0	63	20	1.00E-01 [b]	1.00E-01 [c]	NA	6.30E-02	6.30E-02	NA
Carbon Tetrachloride	000056-23-5	65	21	7.00E-04 [b]	7.00E-03	1.30E-01 [b]	4.55E-04	4.55E-03	2.00E-01
Chlordane	000057-74-9	50	22	6.00E-05 [b]	6.00E-05	1.30E+00 [b]	3.00E-05	3.00E-05	2.60E+00
Chlorobenzene	000108-90-7	31	23	2.00E-02 [b]	2.00E-01	NA	6.20E-03	6.20E-02	NA
Chloroform	000067-66-3	20	24	1.00E-02 [b]	1.00E-02	6.10E-03 [b]	2.00E-03	2.00E-03	3.05E-02
Chromium (III) (Insoluble Salts)	016065-83-1	0.50	74	1.00E+00 [b]	1.00E+00 [c]	NA	5.00E-03	5.00E-03	NA
Chromium (VI)	018540-29-9	2.0	25	5.00E-03 [b]	2.00E-02	NA	1.00E-04	4.00E-04	NA
Chromium Salts	NA	2.0	74	NA	NA	NA	NA	NA	NA
Chrysene	000218-01-9	31	2	NA	NA	NA	NA	NA	NA
Cobalt	007440-48-4	80	26	NA	NA	NA	NA	NA	NA
Copper	007440-50-8	30	27	NA	NA	NA	NA	NA	NA
Cresol, p-	000106-44-5	65	72	5.00E-03 [c]	5.00E-03 [c]	NA	3.25E-03	3.25E-03	NA
Cyanide (CN-)	000057-12-5	17	37	2.00E-02 [b]	2.00E-02 [c]	NA	3.40E-03	3.40E-03	NA
DDD	000072-54-8	70	28	NA	NA	2.40E-01 [b]	NA	NA	3.43E-01

The Dermal Risk Values were calculated using Interim U.S. EPA methodology. However, these values have not been through the U.S. EPA approval process.

DERMAL RISK VALUES DERIVED BY CALCULATION FROM GASTROINTESTINAL (GI) ABSORPTION DATA IN ALPHABETICAL ORDER

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day)		Oral Slope Factor $(mg/kg/day)^{-1}$	Dermal RfD (mg/kg/day)		Dermal Slope Factor $(mg/kg/day)^{-1}$
				Chronic	Subchronic		Chronic	Subchronic	
DDE	000072-55-9	70	28	NA	NA	3.40E-01 [b]	NA	NA	4.86E-01
DDT	000050-29-3	70	28	5.00E-04 [b]	5.00E-04 [c]	3.40E-01 [b]	3.50E-04	3.50E-04	4.86E-01
Dibenz[a,h]anthracene	000053-70-3	31	2	NA	NA	NA	NA	NA	NA
Dibromochloromethane	000124-48-1	60	69	2.00E-02 [b]	2.00E-01 [c]	8.40E-02 [b]	1.20E-02	1.20E-01	1.40E-01
Dibutyl Phthalate	000084-74-2	100	29	1.00E-01 [b]	1.00E+00 [c]	NA	1.00E-01	NA	NA
Dichlorobenzene, 1,4-	000106-46-7	90	82	NA	NA	2.40E-02	NA	NA	2.67E-02
Dichlorodifluoromethane	000075-71-8	23	12	2.00E-01 [c]	9.00E-01 [c]	NA	4.60E-02	2.07E-01	NA
Dichloroethane, 1,1-	000075-34-3	100	80	1.00E-01 [c]	1.00E+00 [c]	NA	1.00E-01	NA	NA
Dichloroethane, 1,2-	000107-06-2	100	30	NA	NA	9.10E-02 [b]	NA	NA	9.10E-02
Dichloroethylene, 1,1-	000075-35-4	100	31	9.00E-03 [b]	9.00E-03 [c]	6.00E-01 [b]	9.00E-03	9.00E-03	6.00E-01
Dichloroethylene, 1,2-cis-	000156-59-2	100	83	1.00E-02 [c]	1.00E-01 [c]	NA	1.00E-02	1.00E-01	NA
Dichloroethylene, 1,2-trans-	000156-60-5	100	83	2.00E-02 [b]	2.00E-01 [c]	NA	2.00E-02	2.00E-01	NA
Dichlorophenol, 2,4-	000120-83-2	82	81	3.00E-03 [b]	3.00E-C3 [c]	NA	2.46E-03	2.46E-03	NA
Dichloropropane, 1,2-	000078-87-5	74	68	NA	NA	6.80E-02	NA	NA	9.19E-02
Dichloropropene, 1,3-	000542-75-6	55	73	3.00E-04 [b]	3.00E-03 [c]	1.80E-01	1.65E-04	1.65E-03	3.27E-01
Dieldrin	000060-57-1	50	65	5.00E-05 [b]	5.00E-05 [c]	1.60E+01 [b]	2.50E-05	2.50E-05	3.20E+01
Diethyl Phthalate	000084-66-2	90	79	8.00E-01 [b]	8.00E+00 [c]	NA	7.20E-01	7.20E+00	NA
Dimethylphthalate	000131-11-3	90	79	NA	NA	NA	NA	NA	NA
Dinitro-o-cresol, 4,6-	000534-52-1	100	12	NA	NA	NA	NA	NA	NA
Dinitrobenzene, 1,2-	000528-29-0	93	32	4.00E-04 [c]	4.00E-03 [c]	NA	3.72E-04	3.72E-03	NA
Dinitrotoluene, 2,4-	000121-14-2	85	33	2.00E-03 [b]	2.00E-03 [c]	6.80E-01 [b,d]	1.70E-03	1.70E-03	8.00E-01
Dinitrotoluene, 2,6-	000606-20-2	85	33	1.00E-03 [c]	1.00E-02 [c]	6.80E-01 [b,d]	8.50E-04	8.50E-03	8.00E-01
Endrin	000072-20-8	2.0	77	3.00E-04 [b]	3.00E-04 [c]	NA	6.00E-06	6.00E-06	NA
Ethylbenzene	000100-41-4	97	10	1.00E-01 [b]	NA	NA	9.70E-02	NA	NA
Fluoranthene	000206-44-0	31	2	4.00E-02 [b]	4.00E-01 [c]	NA	1.24E-02	1.24E-01	NA
Fluoride	007782-41-4	97	34	6.00E-02 [b]	6.00E-02 [c]	NA	5.82E-02	5.82E-02	NA

The Dermal Risk Values were calculated using interim U.S. EPA methodology. However, these values have not been through the U.S. EPA approval process.

DERMAL RISK VALUES DERIVED BY CALCULATION FROM GASTROINTESTINAL (GI) ABSORPTION DATA IN ALPHABETICAL ORDER

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day)		Oral Slope Factor (mg/kg/day)$^{-1}$	Dermal RfD (mg/kg/day)		Dermal Slope Factor (mg/kg/day)$^{-1}$
				Chronic	Subchronic		Chronic	Subchronic	
Heptachlor	000076-44-8	72	35	5.00E-04 [b]	5.00E-04 [c]	4.50E+00 [b]	3.60E-04	3.60E-04	6.25E+00
Heptachlor Epoxide	001024-57-3	72	35	1.30E-05 [b]	1.30E-05 [c]	9.10E+00 [b]	9.36E-06	9.36E-06	1.26E+01
Hexachlorocyclohexane, Alpha-	000319-84-6	97	70	NA	NA	6.30E+00 [b]	NA	NA	6.49E+00
Hexachlorocyclohexane, Beta-	000319-85-7	91	70	NA	NA	1.80E+00 [b]	NA	NA	1.98E+00
Hexachlorocyclohexane, Gamma-	000058-89-9	97	10	3.00E-04 [b]	3.00E-03 [c]	1.30E+00	2.91E-04	2.91E-03	1.34E+00
Hexane, N-	000110-54-3	80 [e]	85	6.00E-02 [c]	6.00E-01 [c]	NA	4.80E-02	4.80E-01	NA
Hexanone, 2-	000591-78-6	66	36	NA	NA	NA	NA	NA	NA
Hydrogen Cyanide	000074-90-8	17	37	2.00E-02 [b]	NA	NA	3.40E-03	NA	NA
Indeno[1,2,3-cd]pyrene	000193-39-5	31	2	NA	NA	NA	NA	NA	NA
Iron	007439-89-6	15	26	NA	NA	NA	NA	NA	NA
Isopropanol	000067-63-0	100	12	NA	NA	NA	NA	NA	NA
Lead And Compounds	007439-92-1	15	26	NA	NA	NA	NA	NA	NA
Lithium	007439-93-2	80	26	NA	NA	NA	NA	NA	NA
Magnesium	007439-95-4	20	26	NA	NA	NA	NA	NA	NA
Manganese (Diet)	007439-96-5	4.0	38	1.40E-01 [b]	1.40E-01 [c]	NA	5.60E-03	5.60E-03	NA
Manganese (Water)	007439-96-5	4.0	38	5.00E-03 [b]	5.00E-03 [c]	NA	2.00E-04	2.00E-04	NA
Mercury, Inorganic	007439-97-6	0.01	26, 39	3.00E-04 [c]	3.00E-04 [c]	NA	3.00E-08	3.00E-08	NA
Mercury, Inorganic Salts	NA	7.0	26	3.00E-04	3.00E-04	NA	2.10E-05	2.10E-05	NA
Methyl Ethyl Ketone	000078-93-3	80	1	6.00E-01 [b]	2.00E+00 [c]	NA	4.80E-01	1.60E+00	NA
Methyl Mercury	022967-92-6	90	26, 39, 40	3.00E-04 [b]	3.00E-04 [c]	NA	2.70E-04	2.70E-04	NA
Methylene Chloride	000075-09-2	95	41	6.00E-02 [b]	6.00E-02 [c]	7.50E-03 [b]	5.70E-02	5.70E-02	7.89E-03
Molybdenum	007439-98-7	38	42	5.00E-03 [b]	5.00E-03 [c]	NA	1.90E-03	1.90E-03	NA
Naphthalene	000091-20-3	80	43	NA	NA	NA	NA	NA	NA
Naphthalene, 1-Methyl	000090-12-0	80	43	NA	NA	NA	NA	NA	NA
Naphthalene, 2-Methyl	000091-57-6	80	43	NA	NA	NA	NA	NA	NA
Nickel Soluble Salts	007440-02-0	27	44	2.00E-02 [b]	2.00E-02 [c]	NA	5.40E-03	5.40E-03	NA

The Dermal Risk Values were calculated using interim U.S. EPA methodology. However, these values have not been through the U.S. EPA approval process.

DERMAL RISK VALUES DERIVED BY CALCULATION FROM GASTROINTESTINAL (GI) ABSORPTION DATA IN ALPHABETICAL ORDER

Chemical	CAS Number	GI Absorption Factor (%)[a]	GI Absorption Reference	Oral RfD (mg/kg/day)		Oral Slope Factor $(mg/kg/day)^{-1}$	Dermal RfD (mg/kg/day)		Dermal Slope Factor $(mg/kg/day)^{-1}$
				Chronic	Subchronic		Chronic	Subchronic	
Nitrobenzene	000098-95-3	97	10	5.00E-04 [b]	5.00E-03 [c]	NA	4.85E-04	4.85E-03	NA
Nitrophenol, 4-	000100-02-7	100	12	NA	NA	NA	NA	NA	NA
Nitroso-di-N-propylamine, N-	000621-64-7	25	45	NA	NA	7.00E+00 [b]	NA	NA	2.80E+01
Nitrosodiphenylamine, N-	000086-30-6	25	45	NA	NA	4.90E-03 [b]	NA	NA	1.96E-02
Octyl Phthalate, di-N-	000117-84-0	90	79	2.00E-02 [c]	2.00E-02 [c]	NA	1.80E-02	1.80E-02	NA
Pentachlorophenol	000087-86-5	100	71	3.00E-02 [b]	3.00E-02 [c]	1.20E-01 [b]	3.00E-02	3.00E-02	1.20E-01
Pentyl Alcohol, N-	000071-41-0	50	12	NA	NA	NA	NA	NA	NA
Phenanthrene	000085-01-8	73	2	NA	NA	NA	NA	NA	NA
Phenol	000108-95-2	90	12	6.00E-01 [b]	6.00E-01 [c]	NA	5.40E-01	5.40E-01	NA
Polybrominated Biphenyls	059536-65-1	93	64	7.00E-06 [c]	7.00E-05 [c]	8.90E+00	6.51E-06	6.51E-05	9.57E+00
Polychlorinated Biphenyls	001336-36-3	90	46	NA	NA	7.70E+00 [b]	NA	NA	8.56E+00
Pyrene	000129-00-0	31	2	3.00E-02 [b]	3.00E-01 [c]	NA	9.30E-03	9.30E-02	NA
Selenious Acid	007783-00-8	87	47	5.00E-03 [b]	5.00E-03 [c]	NA	4.35E-03	4.35E-03	NA
Selenite	014124-67-5	70	48	NA	NA	NA	NA	NA	NA
Selenium	007782-49-2	44	47	5.00E-03 [b]	5.00E-03 [c]	NA	2.20E-03	2.20E-03	NA
Silver	007440-22-4	18	49	5.00E-03 [b]	5.00E-03 [c]	NA	9.00E-04	9.00E-04	NA
Strontium-90	010098-97-2	16	84	NA	NA	NA	NA	NA	NA
Sulfate	014808-79-8	20	50	NA	NA	NA	NA	NA	NA
Tetrachloroethane, 1,1,2,2-	000079-34-5	70	51	NA	NA	2.00E-01 [b]	NA	NA	2.86E-01
Tetrachloroethylene	000127-18-4	100	63	1.00E-02 [b]	1.00E-01 [c]	NA	1.00E-02	1.00E-01	NA
Thallium	007440-28-0	15	52	NA	NA	NA	NA	NA	NA
Thorium	007440-29-1	1.0	53	NA	NA	NA	NA	NA	NA
Tin	007440-31-5	10	26	6.00E-01 [c]	6.00E-01 [c]	NA	6.00E-02	6.00E-02	NA
Titanium	007440-32-6	3.0	26	NA	NA	NA	NA	NA	NA
Toluene	000108-88-3	80	54	2.00E-01 [b]	2.00E+00 [c]	NA	1.60E-01	1.60E+00	NA
Trichloroethane, 1,1,1-	000071-55-6	90	55	NA	NA	NA	NA	NA	NA

The Dermal Risk Values were calculated using interim U.S. EPA methodology. However, these values have not been through the U.S. EPA approval process.

DERMAL RISK VALUES DERIVED BY CALCULATION FROM GASTROINTESTINAL (GI) ABSORPTION DATA IN ALPHABETICAL ORDER

Chemical	CAS Number	GI Absorption Factor (%)[e]	GI Absorption Reference	Oral RfD (mg/kg/day)		Oral Slope Factor $(mg/kg/day)^{-1}$	Dermal RfD (mg/kg/day)		Dermal Slope Factor $(mg/kg/day)^{-1}$
				Chronic	Subchronic		Chronic	Subchronic	
Trichloroethane, 1,1,2-	000079-00-5	81	56	4.00E-03 [b]	4.00E-02 [c]	5.70E-02 [b]	3.24E-03	3.24E-02	7.04E-02
Trichloroethylene	000079-01-6	15	57	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	000075-69-4	23	12	3.00E-01 [b]	7.00E-01 [c]	NA	6.90E-02	1.61E-01	NA
Uranium	007440-61-1	85	26	NA	NA	NA	NA	NA	NA
Uranium, Soluble Salts	NA	85	26	3.00E-03	NA	NA	2.55E-03	NA	NA
Vanadium, Metallic	007440-62-2	1.0	58, 59	7.00E-03 [c]	7.00E-03 [c]	NA	7.00E-05	7.00E-05	NA
Vinyl Acetate	000108-05-4	65	60	1.00E+00 [c]	1.00E+00 [c]	NA	6.50E-01	6.50E-01	NA
Vinyl Chloride	000075-01-4	100	66	NA	NA	1.90E+00	NA	NA	1.90E+00
Xylene, Mixture	001330-20-7	92	61	2.00E+00 [b]	NA	NA	1.84E+00	NA	NA
Zinc (Metallic)	007440-66-6	20	62	3.00E-01 [b]	3.00E-01 [c]	NA	6.00E-02	6.00E-02	NA
Zirconium	007440-67-7	80	12	NA	NA	NA	NA	NA	NA

[a] GI absoprtion factors obtained from literature by BEIA staff
[b] Source: Integrated Risk Information System (IRIS)
[c] Source: Health and Environmental Affects Summary Table (HEAST) 1993
[d] Listed as "Dinitrotoluene mixture, 2,4-/2,6-" in IRIS. The value is based on a study using technical grade DNT.
[e] Interim U.S. EPA Region IV default value

The Dermal Risk Values were calculated using interim U.S. EPA methodology. However, these values have not been through the U.S. EPA approval process.

GI ABSORPTION REFERENCES

Reference Number	Reference
1	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for 2-Butanone. ATSDR/U.S. Public Health Service
2	Rahman, A., J.A. Barrowman and A. Rahimtula. 1986. The influence of bile on the bioavailability of polynuclear aromatic hydrocarbons from the rat intestine. Can. J. Physiol. Pharmacol. 64:1214-1218
3	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for Acetone. ATSDR/U.S. Public Health Service
4	Venugopal, B. and T.D. Luckey. 1978. Metal Toxicity in Mammals-2. Chemical Toxicity of Metals and Metalloids. Plenum Press. pp. 104-112
5	Kortus, J. 1967. The carbohydrate metabolism accompanying intoxication by aluminum salts in the rat. Experientia 23:912-913
6	Rahman, A., J.A. Barrowman and A. Rahimtula. 1986. The influence of bile on the bioavailability of polynuclear aromatic hydrocarbons from the rat intestine. Can. J. Physiol. Pharmacol. 64:1214-1218
7	Gerber, G.B., J. Maes and B. Eykens. 1982. Transfer of antimony and arsenic to the developing organism. Arch. Toxicol. 49:159-168
8	Bettley, F.R., O'Shea, J.A. 1975. The absorption of arsenic and its relation to carcinoma. Br. J. Dermatology. 92:563. (Cited in Hindmarsh and McCurdy, 1986)
9	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for Barium. ATSDR/U.S. Public Health Service
10	Sabourin, P.J., B.T. Chen, G. Lucier, et al. 1987. Effects of dose on the absorption and excretion of [14C]benzene administered orally or by inhalation in rats and mice. Toxicol. Appl. Pharmacol. 87:325-336
11	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Benzidine. ATSDR/U.S. Public Health Service
12	HSDB (Hazardous Substances Data Bank). 1994. MEDLARS Online Information Retrieval System, National Library of Medicine. Retrieved March, 1994
13	Furchner, J.E., C.R. Richmond and J.E. London. 1973. Comparative metabolism of radionuclides in mammals: VII. Retention of beryllium in the mouse, rat, monkey and dog. Health Phys. 24:292-300
14	Reeves, A.L. 1965. The absorption of beryllium from the gastrointestinal tract. Arch. Environ. Health 11:209-214
15	Teirlynck, O.A. and J. Belpaire. 1985. Disposition of orally administered di(2-ethylhexyl)phthalate and mono(2-ethylhexyl)phthalate in the rat. Arch. Toxicol. 57(4):226-230
16	Foulkes, E.C. 1986. Absorption of cadmium. In: Handbook of Experimental Pharmacology. Vol. 80, E.C. Foulkes, ed., Springer-Verlag, Berlin, pp. 75-100
17	Nordberg, G.F., T. Kjellstrom and M. Nordberg. 1985. Kinetics and metabolism. In: Cadmium and Health: A Toxicological and Epidemiological Appraisal. Vol. 1. Exposure, Dose, and Metabolism. L. Friberg, C.G. Elinder, T. Kjellstrom and G.F. Nordberg, eds. CRC Press, Boca Raton, FL, pp. 103-178
18	McLellan, J.S., P.R. Flanagan, M.J. Chamberlain and L.S. Valberg. 1978. Measurement of dietary cadmium absorption in humans. J. Toxicol. Environ. Health 4:131-138
19	Shaikh, Z.A. and J.C. Smith. 1980. Metabolism of orally ingested cadmium in humans. In: Mechanisms of Toxicity and Hazard Evaluation, B. Holmstead, et al., eds. Elsevier/North Holland, Amsterdam. pp. 569-574
20	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for Carbon Disulfide. ATSDR/U.S. Public Health Service
21	U.S. EPA. 1989. Updated Health Effects Assessment for Carbon Tetrachloride. Prepared for the Office Emergency and Remedial Response, Washington, DC. Environmental Criteria and Assessment Office, Cincinnati, OH
22	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for Chlordane. ATSDR/U.S. Public Health Service

GI ABSORPTION REFERENCES

Reference Number	Reference
23	ATSDR (Agency for Toxic Substances and Disease Registry). 1990. Toxicological Profile for Chlorobenzene. ATSDR/U.S. Public Health Service
24	Brown, D.M., P.F. Langely, D. Smith, et al. 1974. Metabolism of Chloroform. I. The metabolism of [14C]-chloroform by different species. Xenobiotica 4:151-163
25	U.S. EPA. 1984. Health Effects Assessment for Chromium. Final Report. Environmental Criteria and Assessment Office. Research Triangle Park, NC. EPA-600/8-83-014F. PB85-115905
26	Goyer, R.A. 1991. Toxic Effects of Metals. In: Casarett and Doull's Toxicology: The Basic Science of Poisons, fourth edition. M. O. Ammdur, J. Doull, and C.D. Klaassen, eds. pp. 623-680
27	Venugopal, B. and T.D. Luckey. 1978. Metal Toxicity in Mammals - 2. Chemical Toxicity of Metals and Metalloids. Plenum Press. pp. 104-112.
28	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for p,p'-DDT, DDE, DDD. ATSDR/U.S. Public Health Service
29	ATSDR (Agency for Toxic Substances and Disease Registry). 1990. Toxicological Profile for Di-n-Butylphthalate. ATSDR/U.S. Public Health Service
30	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for 1,2-Dichloroethane. ATSDR/U.S. Public Health Service
31	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for 1,1-Dichloroethene. ATSDR/U.S. Public Health Service
32	Parke, D. 1961. Studies in detoxification. V. The metabolism of m-dinitro[14C]benzene in the rabbit. Biochem. J. 78:262-271
33	U.S. EPA. 1986. Health and Environmental Effects Profile for Dinitrotoluene. Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office. Cincinnati, OH. ECAO- CIN-P183
34	ATSDR (Agency for Toxic Substances and Disease Registry). 1991. Toxicological Profile for Fluoride, Hydrogen Fluoride, and Fluorine. ATSDR/U.S. Public Health Service
35	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Heptachlor/Heptachlor Epoxide. ATSDR/U.S. Public Health Service
36	ATSDR (Agency for Toxic Substances and Disease Registry). 1992. Toxicological Profile for 2-Hexanone. ATSDR/U.S. Public Health Service
37	U.S. EPA. 1984. Health Effects Assessment for Cyanides. Prepared by the Environmental Criteria and Assessment Office, Cincinnati, OH for the Emergency and Remedial Response Office, Washington, DC. EPA/540/1-86-011
38	U.S. EPA. 1990. Integrated Risk Information System (IRIS). Health Risk Assessment for Manganese. On line. (Verification date 6/21/90). Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH
39	ATSDR (Agency for Toxic Substances and Disease Registry). 1989. Toxicological Profile for Mercury. ATSDR/U.S. Public Health Service
40	Miettinen, J.K. 1973. Absorption and elimination of dietary (Hg++) and methylmercury in man. In: Mercury, Mercurials, and Mercaptans, M.W. Miller and T.W. Clakrson, Eds. Springfield, IL pp 233-243
41	Angelo, M.J., A.B. Pritchard, D.R. Hawkins, et al. 1986. The pharmacokinetics of dichloromethane. I. Disposition in B6C3F1 mice following intravenous and oral administration. Food Chem. Toxicol. 24:965-974
42	Friberg, L. and J. Lener. 1986. Molybenum. In: Handbook on the Toxicology of Metals. 2nd ed. L. Friberg, G.F. Nordberg and V.B. Vouk, eds. Elsevier/North-Holland Biomedical Press, New York. pp. 446-461
43	ATSDR (Agency for Toxic Substances and Disease Registry). 1993. Toxicological Profile for Naphthalene. ATSDR/U.S. Public Health Service

APPENDIX E-2

AVAILABLE ENVIRONMENTAL CRITERIA

ORNL/M-4097

REVIEW OF BIOMONITORING STUDIES AND ECOLOGICAL SURVEYS CONDUCTED AT U.S. MILITARY INSTALLATIONS

March 1995

Dennis M. Opresko Ph.D.

Health Sciences Research Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Prepared
for

Hazardous Waste Remedial Action Program
Martin Marietta Energy Systems, Inc
Oak Ridge, TN

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831
operated by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE
U.S. DEPARTMENT OF ENERGY
Under Contract No. DE-AC05-84OR21400

TABLE OF CONTENTS

INTRODUCTION

Many U.S. military installations encompass large tracts of land on the order of tens of thousands of acres. These installations, which have been in operation for many years, usually include surplus acreage as well as perimeter and buffer zones that represent natural areas left undisturbed by military activities. Consequently, over the years these sections of each installation have remained as habitat for indigenous species of flora and fauna. The plants and animals found on these sites may come into contact with or be exposed to chemical substances that are manufactured, processed, tested, used, or disposed of as a result of past and current operations. Such chemical substances may be released into the environment in atmospheric emissions or wastewater effluents, through the deposition of solid wastes in landfill sites, through accidental leaks or spills, or through open burning/open detonation (OB/OD) activities. The effect of such activities on ecological communities within or adjacent to individual military installations has only recently been the subject of scientific investigations.

This report summarizes some of the ecological surveys and biomonitoring studies that have been conducted at U.S. military installations. Relevant studies were identified through a computerized search of the Defense Technical Information Center bibliographic database and through personal contacts with agencies involved in such studies.

The report is divided into two parts; one dealing with studies of terrestrial communities and one dealing with studies of aquatic communities.

TERRESTRIAL STUDIES

1. Site: ABERDEEN PROVING GROUND (APG), Maryland

Site activities: Research, development and testing of munitions and military vehicles.

Primary Contaminants: Explosives, PCBs, metals and pesticides.

Type of study: Deer tissue samples were analyzed for contaminants.

Results: No detectible levels of explosives, PCBs or organochlorine pesticides (DDT, DDD, DDE) were found in the deer tissue. Low concentrations of several heavy metals (arsenic, cadmium, chromium, mercury and lead) were found in muscle and liver of deer from APG and from several background sites in Maryland. The objective of the study was to evaluate the potential human health risks associated with consumption of deer meat by hunters. The study was not intended to evaluate potential adverse ecological effects; however, the number of deer harvested per year from the APG reservation (1000) suggests that the overall environmental conditions on APG are not detrimental to the deer population.

Reference: U. S. Army Center for Health Promotion and Preventive Medicine. 1994. Health Risk Assessment of Consuming Deer from Aberdeen Proving Ground, Maryland. Draft. Field Study No. 75-23-YS50-94, Aberdeen Proving Ground, MD.

2. Site: ALABAMA ARMY AMMUNITION PLANT, Childerburg, Alabama

Site activities: Manufacture of munitions.

Primary Contaminants: TNT and metabolites.

Type of study: Deer, quail and rabbit tissue samples were analyzed for contaminants.

Results: Levels of TNT and metabolites in deer, quail and rabbit tissue were below the detection limits of 0.2 mg/kg.

Reference: Shugart, L., et al. 1991. TNT Metabolites in Animal Tissues. Final Report - December, 1990. ORNL/M-1336. Oak Ridge National Laboratory. Oak Ridge, TN

3. Site: BADGER ARMY AMMUNITION PLANT, Baraboo, Wisconsin

Site activities: Manufacture of munitions.

Primary Contaminants: 2,4-Dinitrotoluene and 2,6-dinitrotoluene.

Type of study: Deer tissue samples were analyzed for contaminants.

Results: Levels of 2,4-dinitrotoluene and 2,6-dinitrotoluene in deer tissue were below the detection limit of 0.1 mg/kg.

Reference: Shugart, L.R. 1991. Dinitrotoluene in Deer Tissue. Final Report. ORNL/M-1765. Oak Ridge National Laboratory. Oak Ridge, TN

4. Site: FORT DIX, New Jersey

Site activities: Class I Army installation consisting of training areas and range complex; USATRATCOM station; and Frankford Arsenal Test Site.

Primary contaminants: Small arms munitions, pyrotechnic and white phosphorus rounds.

Type of study: Records search to determine possible environmental contamination, and to assess the possibility of contaminant migration beyond the installation boundary.

Results: Impact range is contaminated with unexploded ordnance rounds. Chemical munitions used at the installation were limited to pyrotechnic and riot control rounds (e.g., smoke CS, CN). BOMARC site contaminated with radiological material. "With respect to Fort Dix proper (excluding the Air Force BOMARC Site), the available records do not indicate that any contaminants are migrating beyond the boundaries of Fort Dix".

The report also noted that Fort Dix is part of the New Jersey Pine Barrens of the Atlantic Coastal Plain. Waters and soils are acidic and low in calcium which may limit the kinds of animals that inhabit the area. Numerous insect species, but few bird species were present. Snails and worms were absent or rare. Species of fish and amphibians were limited. Appendix C of the report is a checklist of the species of fish, amphibians, reptiles, birds, mammals, and plants that have been reported from the Pine Barrens; however, there is no faunal survey of specific sites within Fort Dix, such as at and downwind from the OB/OD areas; therefore, an assessment of ecological impacts cannot be made from the data in the report.

Reference: Wingfield, D.D., 1977. Installation Assessment of Fort Dix (BOMARC Site). Report 108, March, 1977. U.S Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, MD.

5. Site: JOLIET ARMY AMMUNITION PLANT, Joliet, Illinois

Site activities: TNT manufacturing facility (1942-1977); load and pack areas, lead azide area, and open burning areas.

Primary Contaminants: TNT, lead azide. Chemical residues found in soil included TNT, TNB (1,3,5-trinitrobenzene), 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, RDX, and HMX.

a) Type of study: Deer tissue samples were analyzed for contaminants.

Results: No detectible levels of TNT, TNT metabolites, RDX, HMX, 2,4-dinitrotoluene, or 2,6-dinitrotoluene were found in the deer tissue analyzed. Some tissue concentrations of metals (arsenic cadmium, mercury and lead) were identified in muscle, liver, kidney and bone. The study was designed to evaluate human health risks associated with consumption of deer meat by hunters. No evaluation was made of adverse effects on the deer; however, it was reported that the site supports a deer population of 2000.

Reference: U. S. Army Environmental Hygiene Agency, Toxicology Division. 1994. Health Risk Assessment from Consumption of Deer Muscle and Liver from Joliet Army Ammunition Plant, Joliet, Illinois. Report No. 75-51-YF23. Prepared for the U.S. Army Environmental Center, Aberdeen Proving Ground, Maryland.

b) Type of study: Toxicity testing was conducted on soil samples from six test sites and a control site. The soil tests included an early seedling growth and vigor test (cucumber and radish), and an earthworm survival and growth test. Leachates from the soil samples were tested using the Microtox assay (Photobacterium phosphoreum).

Results: "Two of 15 soil samples from the open burning area on the manufacturing side of the plant (Area 2) were highly toxic in all three types of tests, 2 others were toxic in only one of the 3 tests. Seventeen of 32 samples from a load and pack burning ground (Area L2) were toxic in one or more of the 3 types of tests. Fourteen of 31 samples from a WW II load and pack area were toxic in one or more of the 3 types of tests. Four of 32 samples from the TNT ditch complex were toxic. One of 13 samples from the lead azide area was toxic to earthworms, but not to plants or in the Microtox assay. One of 7 samples taken from around a holding pond used to contain explosive water residue was found to be toxic to cucumbers. "Scatter plot analyses of toxicity assay results indicated that the NOEL and LOEL of TNT ranged from approximately 30 to 90 mg/kg...Lethal effects and growth reduction of plants and earthworms and reduced Microtox percent EC_{50}s (<70%) began in this range...Other contaminants may have had an affect on the bioassay and, consequently, on the NOEL and LOEL".

Reference: Phillips, C.T. et al., 1994. Toxicity Testing of Soil Samples from Joliet Army Ammunition Plant, Joliet, IL. U.S. Army Edgewood Research, Development and Engineering Center, Aberdeen Proving Ground, MD. AD-A279091.

6. Site: NEWPORT ARMY AMMUNITION PLANT, Newport, Indiana

Site activities: RDX manufacturing facility from 1943-45. TNT production started in 1973.

Primary contaminants: TNT

Type of study: Mammals, birds, amphibians, reptiles and plants were surveyed. Sites impacted by munitions storage, industrial use, administrative use, and land contamination were compared to reference sites within the installation boundaries. The latter included fields used for agriculture and woodlands (some of which were slated for future use as a red water ash basin and as a TNT burning grounds).

Results: "No significant ecological damage due to installation operations was found. Disparities in the composition of some ecological communities (e.g., birds) between cantonment (experimental) and less disturbed areas (reference) of the installation were apparently due to habitat differences. An abundance of predators and high densities of prey populations suggest that normal faunal community structures exist at NAAP".

Reference: Pinkham, C.F.A. et al. 1976. Terrestrial Ecological Surveys at Newport Army Ammunition Plant, Indiana. Edgewood Arsenal Technical Report. EO-TR-76044. Edgewood Arsenal, Aberdeen Proving Ground, MD.

7. Site: PINE BLUFF ARSENAL, Pine Bluff, Arkansas

Site activities: Prior activities; manufacture of magnesium and thermite types of incendiary bombs, manufacture of war gases, incendiary smoke munitions, chemical munitions containing chlorine, mustard gas and lewisite, manufacture of chlorine and DDT.

Primary Contaminants: Three areas were highly contaminated with toxic chemicals; one area contained mustard gas, DDT and possibly arsenic; the second contained chloroacetophenone, adamsite, pyrotechnics, munitions, smokes and incendiaries; the third contained elemental phosphorus, DDT, pyrotechnics and munitions.

Type of study: Mammals, birds, amphibians, reptiles, and plants were surveyed. Sites impacted by munitions manufacture, testing, storage, open burning, administrative use, and land contamination were compared to reference sites within installation boundaries. The latter

included woodlands managed for timber and recreation.

Results: "Nothing in the data on mammals sighted indicates a generally adverse effect of PBA activities. The trap site with a success rate that was significantly lower than the site with the highest rate was in an area known to be free of disturbance. The rodent populations were low compared to similar populations elsewhere and potential predators (at least six species of predatory mammals, four species of birds of prey, and four species of predatory snakes) were relatively common. Whether the mammal population was at a low in a cyclic pattern or a balance had been reached between the food source, cover, and predator pressure could not be determined......Bird populations exhibited no adverse effects from the activities at PBA. There were both numerous species and individuals.....Amphibians and reptiles were well represented, and showed no widespread adverse effect. Nor were there significantly fewer species of amphibians in the experimental areas. In a few limited pond and stream locations in sector 12 and 13 amphibians and aquatic invertebrates were absent. The pH conditions were unacceptable to sustain life".

Reference: Pinkham, C.F.A. et al. 1977. Terrestrial Ecological Surveys at Pine Bluff Arsenal, Pine Bluff, Arkansas. Edgewood Arsenal Technical Report. EO-TR-77029. Edgewood Arsenal, Aberdeen Proving Ground, MD. AD A043292.

8. Site: TOOELE ARMY DEPOT, Tooele, Utah

Site activities: Repository for chemical agents.

Primary Contaminants: GB, VX, mustard.

Type of study: Small mammals were surveyed. Blood AChE levels were measured in jackrabbits and deer mice.

Results: Baseline information was obtained concerning population densities of small mammals over a three-year period. Population densities of blacktailed jackrabbits increased from about 30/acre in April of 1973 to about 60/acre in August of 1975, and it was reported that this increase was part of a natural longterm cycle. Deer mice and least chipmunks were codominants in the small rodent community. Population densities of deer mice, as indicated by trapping success, were not different among six surveillance sites. A longterm population cycle of 3 years was suggested by the data. Blood AChE levels in jackrabbits and deer mice were not significantly different between onsite, offsite and laboratory animals.

Reference: Gauthier, D.A, et al. 1977. Baseline Ecological Survey of Selected Small Mammals on Tooele Army Depot, South Area, Tooele, Utah. Report No. DPG-FR-X950A. U.S. Army Dugway Proving Ground, Dugway, Utah

9. Site: TWIN CITIES ARMY AMMUNITION PLANT, New Brighton, Minnesota

Site activities: Plant currently on standby. Prior activities: fabrication, loading and proof-testing of small arms ammunition; production of primers and tracers; cleaning, preserving and storage of industrial and machine tools. Current use by private firms involves the use of radionuclides.

Primary Contaminants: Metals (cadmium, chromium, mercury, nickel, lead and antimony), cyanide, organic solvents, PCBs.

Type of study: Mammals, birds, amphibians and reptiles were surveyed.

Results: "...the baseline information assembled here indicates the existence of apparently healthy biotic communities at TCAPP". Concerning impacts on the small mammal population, the authors state "most of the animals tested were not carrying a detectable body burden of contaminants..." Metal concentrations in deer tissue did not exceed background or detection limits. Overpopulation problems indicated that the resident deer herd was reproductively healthy.

Reference: U.S. Army Environmental Hygiene Agency. 1991. Ecological Assessment of Twin Cities Army Ammunition Plant (TCAAP), New Brighton, Minnesota, February 1990 - April 1991, Aberdeen Proving Ground, MD.

AQUATIC STUDIES

1. Site: BADGER ARMY AMMUNITION PLANT, Baraboo, Wisconsin

Site activities: Production of nitrocellulose, nitroglycerine and rocket paste.

Type of study: Periphyton populations were surveyed using artificial substrates and benthic macroinvertebrate populations were surveyed using natural and artificial substrates in impacted and reference streams.

Primary effluent constituents: Nitrocellulose and nitroglycerine.

Results: Nitrocellulose - concentrations in the receiving waters ranged from 1.0 to 12.1 ppm; concentrations in sediments ranged from 17.8 to 296.0 ppm. Periphyton populations were reduced in the wastewater receiving stream and settling pond, but not in receiving water body (Grueber's Bay). Benthic macroinvertebrate populations were reduced in wastewater

receiving stream, settling pond, and in sediments of receiving water body (Grueber's Bay), but water quality was "good to excellent". "Macroinvertebrates living in or on natural substrates near the head of Grueber's Bay were experiencing some environmental stress. The cause of this was again believed to be something other than dissolved nitrocellulose. Possible anaerobic conditions or physical habitat alterations due to nitrocellulose manufacturing wastewater discharge may account for the observed effects".

Nitroglycerin - Concentration of nitroglycerin in two ponds receiving nitroglycerin manufacturing wastes were 7.4 and <1.83 mg/L; sediment concentrations were 37.5 and <2.2 mg/L. Both ponds had depauperate algal communities and no benthic macroinvertebrates. "Algae and macroinvertebrate communities were adversely impacted at nitroglycerine concentrations of ≈ 3 ppm. Therefore, "no effect" levels of NG concentration lie well below 3.0 ppm for both groups studied".

<u>Reference:</u> Stilwell, J.M. et al. 1976. Aquatic Life Field Studies at Badger Army Ammunition Plant. Final Phase II Report (volume I). Battelle Columbus Lab., Columbus, OH. AD A033547.

2. <u>Site:</u> EGLIN AIR FORCE BASE, Florida

<u>Site activities:</u> Testing of conventional munitions.

a) <u>Type of study:</u> Macroinvertebrates were sampled in two streams adjacent to test area.

<u>Primary effluent constituents:</u> Not reported.

<u>Results:</u> "Considering the physico-chemical parameter values, the numbers and kinds of organisms found, and their diversity, evenness, and trophic structure, it must be concluded that the water quality of Bull Creek and Ramer Branch is extremely high".

<u>Reference:</u> Scheiring J.F. and R.C. Crews. 1983. Benthic Macroinvertebrates of Bull Creek and Ramer Branch, Eglin AFB Reservation. Final Report for the period August 1979-June 1980. Environics Office, Air Force Armament Laboratory, Eglin Air Force Base, FL. AFATL-TR-83-24 AD A132946.

b) <u>Type of study:</u> Macroinvertebrates were sampled in a stream adjacent to test area.

<u>Primary effluent constituents:</u> Not reported.

<u>Results:</u> "Considering the physico-chemical parameter values, the numbers and kinds of organisms found, and their diversity, evenness, and trophic structure, it must be concluded that the water quality of Rocky Creek is extremely high".

Reference: Scheiring J.F. et al. 1981. Benthic Macroinvertebrates of Rocky Creek, Eglin AFB Reservation. Final Report for the period July 1978-June 1979. Environics Office, Air Force Armament Laboratory, Eglin Air Force Base, FL. AFATL-TR-81-95. AD A115530.

c) Type of study: Fish were sampled in streams adjacent to the test area.

Primary effluent constituents: Not reported.

Results: "Seventeen species of fish and one lamprey species were collected and catalogued...Many streams were found to serve as the habitat for an endangered species, the Okaloosa darter (Etheostoma okaloosae Fowler)...Because of the qualitative nature and the brevity of the study, plus the fact that no previous baseline data existed on the streams, no conclusions could be drawn concerning the possibility of changes in the stream ecology as a result of testing or other activities on the Eglin AFB reservation". (Author abstract).

Reference: Crews, R. 1976. Aquatic Baseline Survey of Selected Test Areas on Eglin Air Force Base Reservation, Florida. Final Report for the period Nov.-Dec. 1975. Air Force Armament Laboratory, Eglin Air Force Base, FL. AFATL-TR-81-95. AD A115530. [Abstract only]

3. Site: HOLSTON ARMY AMMUNITION PLANT, Kingsport, Tennessee

Site activities: Loading, assembling, packaging, storing, and shipping of mortar and cannon shells, grenades, mines, and cluster bombs.

Primary effluent constituents: RDX, HMX, TNT, nitrogen, dissolved solids. RDX residues of <5 to 70 μg/L (maximum 700 μg/L) were detected in the receiving stream nearly one mile downstream, but none in the stream sediments. No HMX or TNT residues were found in river water, but TNT was found in sediments at up to 4.2 mg/kg. HMX sediment levels were $\leq$0.2 mg/kg.

Type of study: Periphyton and macroinvertebrates were surveyed.

Results: "Maximum impact [to macroinvertebrates] in the river sediments was observed immediately below the two upper production line outfalls...was limited to a short reach extending 100 to 200 yards downstream...Whole river effects were not discernible". Effects seen may have been caused "not only by RDX, but also by associated carbon and nitrogen carbons". "Overall effects of munition effluents were most clearly observed in the periphytic community and were confined to the vicinity of the waste outfalls". "Direct relationship of RDX residues with biotic responses in this system must be approached with caution". Variable waste discharges, upstream waste inputs, flow variability, nitrogen and carbon

loading, and overall eutrophic conditions and biological stress due to upstream discharges may have contributed to the observed effects. "Conservative estimates, however, would place a critical range of 20 to 100 μg/L RDX for periphyton in water containing munitions effluent".

Reference: Sullivan, J.H. et al. 1977. Aquatic Field Surveys at Holston Army Ammunition Plant, Kingsport, TN. Final Report. Water and Air Research, Inc. Gainesville, FL. AD A041627.

4. Site: IOWA ARMY MUNITION PLANT, Burlington, Iowa

Site activities: Loading, assembly and packaging of high explosive munitions.

Primary effluent constituents: 2,4,6-Trinitrotoluene.

Type of study: Periphyton and benthic macroinvertebrate populations were surveyed from natural and artificial substrates in impacted and reference streams.

Results: "Observed trends in the biological communities appeared to correspond to simultaneous variations in the nutrient levels and α-TNT concentrations in the aqueous and sediment environments". At one station where benthic diversity was sharply decreased, sediment TNT levels were greatest (110.6 mg/kg). "Benthic macroinvertebrate populations and species diversity were most affected by the industrial waste effluents when in direct contact with the soft sediments and least affected when associated with harder sediments".

Reference: Sanocki, S.L. et al. 1976. Aquatic Field Surveys at Iowa, Radford and Joliet Army Munition Plants. Final Report, vol. 1., Iowa Army Ammunition Plant. Environmental Control Technology Corporation, Ann Arbor, MI. AD A036776.

5. Site: LONGHORN ARMY AMMUNITION PLANT, Marshall, TX

Site activities: Manufacture and assembly of propellants, rockets, missile motors, pyrotechnics and chemical materials.

Type of study: Phytoplankton, periphyton, zooplankton, fish, and benthic macroinvertebrate populations were surveyed in the effluent-receiving streams and in a control stream.

Primary effluent constituents: Tetranitrocarbazole (TNC)

Results: "Statistically, there were insufficient differences in samples from potentially affected streams and the control stream to conclude that biologic differences due to munition wastes exist.... Evaluation of the data was hampered by the fact that no adequate analytical technique

exists for measuring trace amounts of TNC in water".

Reference: Fox, J.L. et al. 1975. Aquatic Field Surveys at Longhorn and Louisiana Army Ammunition Plants. volume 1, Longhorn Army Ammunition Plant, Water and Air Research, Inc. Gainesville, FL. AD A015007.

6. Site: LOUISIANA ARMY AMMUNITION PLANT, Shreveport-Bassier City, Louisiana

Site activities: Not reported in abstract.

Type of study: Phytoplankton, periphyton, zooplankton, fish, and benthic macroinvertebrate populations were surveyed in the effluent-receiving streams and in a control stream.

Primary effluent constituents: TNT

Results: "Results showed that there were insufficient differences in samples from potentially affected streams and the control stream to conclude that biologic differences due to munition wastes exist... Based on biological findings, the waste ponds fit into two groups, one moderately stressed and one heavily stressed. The amount of stress seemed to be proportional to the amount of TNT, which ranged from <1 to 60 mg/L, in the ponds".

Reference: Fox, J.L. et al. 1975. Aquatic Field Surveys at Longhorn and Louisiana Army Ammunition Plants. volume 2, Louisiana Army Ammunition Plant, Water and Air Research, Inc. Gainesville, FL. AD A015008.

7. Site: MILAN ARMY AMMUNITION PLANT, Milan Tennessee

Site activities: Loading, assembling, packaging, storing, and shipping of mortar and cannon shells, grenades, mines, and cluster bombs.

Primary effluent constituents: TNT and RDX.

Type of study: Bacteria, phytoplankton, periphyton, zooplankton, protozoa, macroinvertebrates and fish were surveyed at five stations along Rutherford Fork.

Results: A low abundance of aquatic organisms was found in Rutherford Fork, the primary receiving stream for munition wastes. The low abundance was reported to be due primarily to the "channelized nature of the stream with its fluctuating flows, high suspended sediments load and lack of suitable habitats". "These prevailing conditions make the observation of significant effluent effects and drawing of firm conclusions about the impact of MAAP

impossible within the limitations of this initial study". "The operation of MAAP has not had an apparent significant impact on the aquatic flora or fauna of the Rutherford Fork of the Obion River".

Reference: Huff et al. 1976. Aquatic Field Surveys at Radford, Holston, Volunteer, and Milan Army Ammunition Plants. vol. IV, Milan. Wapora, Incorporated, Washington, DC. AD A024194.

8. Site: PINE BLUFF ARSENAL, Pine Bluff, Arkansas.

Site activities: White phosphorus munitions filling facility.

Type of study: Macroinvertebrates were sampled.

Primary effluent constituents: White phosphorus and DDT.

Results: "Species abundance and distribution of benthic macroinvertebrates were affected by the concentration of elemental phosphorus...Temporal differences in lake macroinvertebrate species distribution were related to habitat and seasonal changes, whereas spatial differences were related to elemental phosphorus distribution...The receiving water, White Phosphorus Creek, is essentially devoid of life forms other than algae and bacteria..."

Reference: Pearson, J.G. et al. 1976. Effects of Elemental Phosphorus on the Biota of Yellow Lake, Pine Bluff Arsenal, Arkansas, March 1974 - January 1975. Edgewood Arsenal, Aberdeen Proving Ground, MD. AD A035925.

9. Site: RADFORD ARMY AMMUNITION PLANT (RAAP), Radford, Virginia

Site activities: TNT manufacturing facility.

a) Type of study: Fish, bottom fauna, algae and higher plants were surveyed and compared to reference areas and historical data.

Primary effluent constituents: Separate effluents from the TNT manufacturing plant, burning ground runoff, neutralized acid, oleum plant, and power plant.

Results: "The waste discharges from the plant caused localized damage to the fauna and flora of the New River; however, the river had recovered in the five miles contained within the boundaries of the plant property".

TNT wastewater - Wastewater is discharged to Strouble's Creek before entering the New River. "The entire stretch of Strouble's Creek was in a degraded state throughout RAAP

property. Therefore, it was impossible to evaluate the effects of waste discharges on the biota of the creek". Fish fauna was reduced and bottom fauna was of the pollution-tolerant type in Strouble's Creek. Waste carried from Strouble's Creek "through apparent nutrient enrichment were stimulating the growth of higher plants in the New River. It is possible that nitrogen-containing waste from the TNT process were contributing to this enriched condition".

Burning Ground Runoff - "Immediately downstream from the burning ground, only 37 taxa of algae were recorded, indicating a possible toxic runoff". Immediately adjacent to the runoff area "there was no significant difference in sample composition of nine samples (of benthic macroinvertebrates) even though samples 5-9 were exposed to effluents containing, in part, nitro-bodies, ash, neutralized acids, inorganics, and heated water".

Reference: Cairns, J and K.L. Dickson. 1973. The Effects of Waste Discharges from Radford Army Ammunition Plant on the Biota of the New River, Virginia. Virginia Water Resources Research Center, Blacksburg, VA. PB 219 982.

b) **Type of study:** Macroinvertebrates were surveyed at sampling stations along the New River.

Results: "Macroinvertebrate diversity was reduced below the C-line Acid Neutralization Facility and Nitroglycerin Area No. 1 discharges and remained at a low level. Decreased macroinvertebrate community diversity was found at the stations on Stroubles Creek below the major solvent and thermal discharges as compared with an upstream reference station".

Reference: Huff et al. 1976. Aquatic Field Surveys at Radford, Holston, Volunteer, and Milan Army Ammunition Plants. vol. I, Radford. Wapora, Incorporated, Washington, DC. AD A024191. [Abstract only]

10. **Site:** SUNFLOWER ARMY AMMUNITION PLANT, Lawrence, KS

Site activities: N line munitions production, F line, burning ground, storage, solvents, nitroglycerin, nitrocellulose, acids, paste, sewage treatment.

Type of study: Benthic macroinvertebrates were sampled.

Primary effluent constituents: Not reported.

Results: Three benthic sampling sites were located along Captain Creek which runs through part of the installation burning ground. Three other sampling sites were located along two other creeks, one of which (Kill Creek) receives discharges from the munition production area (F-line), the paste and nitroglycerin areas, and the acid area. Statistical analysis of the samples "showed that there were no statistical differences between the six creek stations

based on the mean number of taxa, mean total number of individuals, and mean diversity... From the results shown in this report, current discharges to Kill Creek are minimal, and they do not cause significant changes in stream biota. Captain Creek receives runoff from the disposal and burning sites, the solvent area and the proposed nitroguanidine area...It appears that these sources are insignificant at current operation levels when compared with nutrient additions from surrounding farm and pasture lands".

Reference: Pearson, J.G. et al. 1977. Results of Aquatic Ecological Surveys at Sunflower Army Ammunition Plant, Lawrence, Kansas. Chemical Systems Laboratory, Aberdeen Proving Ground, MD. AD A042862.

11. Site: VOLUNTEER ARMY AMMUNITION PLANT, Chattanooga, Tennessee

Site activities: TNT manufacturing facility.

Primary effluent constituents: 2,4-DNT, 2,6-DNT, TNT.

a) Type of study: Aquatic - bacteria, protozoa, phytoplankton, periphyton, zooplankton, macroinvertebrates and fish were surveyed in the receiving water body, Waconda Bay, Chickamauga Lake.

Results: "Zooplankton numerical abundance was reduced in upper Waconda Bay. Benthic macroinvertebrate diversity was reduced in upper Waconda Bay. The biological sampling indicates that the macroinvertebrate community recovered or nearly recovered within the confines of Waconda Bay".

Reference: Huff et al. 1975. Aquatic Field Surveys at Radford, Holston, Volunteer, and Milan Army Ammunition Plants. vol. III, Volunteer. Wapora, Incorporated, Washington, DC. AD A024193. [Abstract only]

b) Type of study: Phytoplankton, periphyton, and benthic macroinvertebrate populations were surveyed in the effluent-receiving water body (Waconda Bay) and two similar but unaffected reference streams.

Primary effluent constituents: 2,4-DNT, 2,6-DNT, TNT.

Results: At the bayhead, where munitions residues were up to 345 ppb (median concentrations 123 ppb and 56 ppb during two summer surveys), toxicity was noted in the periphyton and benthic macroinvertebrate populations. "Little reduction was noted in the concentration of the specific munitions measured from the outfall to distances downbay of approximately three-eighths of a mile. Since the biologic response significantly shifted from toxic to biostimulatory, it is unlikely that the toxicity was due specifically to any of these three

compounds which persisted in the environment. Nevertheless, it was observed that when munitions concentrations dropped below 20 ppb, no further biologic responses were evident. At munitions concentrations between 40 and 80 ppb, slight biostimulatory effects were noted. Based on these results, it is concluded that environmental impact of TNT effluent would be minimal if the combined concentration of α-TNT, 2,4-DNT, and 2,6-DNT did not exceed 20 ppb in the receiving waters".

Reference: Sullivan, J.H. Jr. et al. 1977. Aquatic Field Surveys at Volunteer Army Ammunition Plant, Chattanooga, Tennessee. Final Report, Water and Air Research, Inc. Gainesville, FL. AD A042590.

SUMMARY

The results of the biomonitoring studies and ecological surveys described above are summarized in this section by ecological or taxonomic group.

TERRESTRIAL ORGANISMS

Whitetail deer - The status of resident deer populations and the possible accumulation of chemical contaminants in deer tissue were investigated in several studies conducted at five Army installations. In general, the large size of the deer populations indicated that current conditions at these sites were not adversely affecting deer reproduction. Analysis of deer tissue revealed that organic contaminants derived from explosives (i.e., TNT, DNT, RDX and HMX) were not present at concentrations above detection limits of 0.1-0.2 mg/kg. At two Army sites, metal concentrations in deer tissue were generally below detection limits or similar to background levels; however, at two other sites (Aberdeen Proving Ground and Joliet Army Ammunition Plant), concentrations of arsenic were elevated in some samples. Similar levels were also seen in offsite populations and no evidence was presented to indicate that these levels were toxic to the deer.

Small mammals - Only a limited amount of information is available on the potential impacts of environmental contaminants on small mammal populations at military sites. At Pine Bluff Arsenal, rodent populations were low compared to reference sites; however, populations of predatory animals were high suggesting the possibility of increased predatory pressure. At Alabama Army Ammunition Plant, analysis of rabbit tissue for TNT and TNT metabolites indicated that these chemicals were not present at concentrations above the detection limit of 0.2 mg/kg. At Twin Cities Army Ammunition Plant, concentrations of PCBs and heavy metals in small mammal tissue were, in most cases, below analytical detection limits.

Birds - Bird populations at several Army installations including Pine Bluff Arsenal and Twin Cities Army Ammunition Plant exhibited no apparent adverse effects from site activities. At Newport Army Ammunition Plant, differences in avian fauna between impact and reference sites were attributed to habitat differences. At Fort Dix, bird species diversity was low, even though insect diversity was high. It was noted in the report that the unique ecological factors associated with the Pine Barrens habitat characteristic of the Fort Dix reservation might limit the number of species occurring there.

Little information is available on the possible accumulation of contaminants in tissues of birds inhabiting military sites. At Alabama Army Ammunition Plant, quail tissue was analyzed for residues of TNT and TNT metabolites. These substances were either absent or present at concentrations below the detection limit of 0.2 mg/kg.

Earthworms - Several soil samples from open burning and disposal areas at Joliet Army Ammunition Plant were found to be toxic to earthworms. For TNT, the NOEL and LOEL for lethal effects and growth reduction ranged from 30 to 90 mg/kg.

Plants - Soil samples collected at Joliet Army Ammunition Plant and containing 30-90 mg TNT/kg soil were found to be toxic to cucumber and radish seedlings.

Microorganisms - Leachates of soil samples taken from an open burning area at Joliet Army Ammunition Plant were found to be toxic to *Photobacterium phosphoreum*.

AQUATIC ORGANISMS:

Fish - At some military installations (Longhorn and Louisiana Army Ammunition Plants, Eglin Air Force Base), fish populations in the receiving streams appeared to be unaffected by wastewater effluents. However, at other installations (Milan, Radford, and Fort Dix), the fish fauna was reduced in onsite streams or rivers. It was reported that the reduced fish fauna at Fort Dix might, in part, be due to naturally occurring high stream acidity, and that at Milan might be due to a lack of suitable stream habitat. The receiving stream at Radford contained TNT residues.

Macroinvertebrates - Benthic macroinvertebrate communities may be adversely affected by wastewater effluents containing various explosive components (nitroglycerin, TNT, RDX, and HMX). At Badger Army Ammunition Plant, macroinvertebrate populations were severely impacted by nitroglycerin concentrations of about 3 ppm. At Radford Army Ammunition Plant, wastewater discharges from a nitroglycerin area (as well as from an acid neutralization facility) were associated with reduced macroinvertebrate diversity in the receiving water; however, macroinvertebrate populations appeared to be unaffected by runoff from the burning ground area. Runoff from a burning area at Sunflower Army Ammunition Plant also had no apparent effect on the macroinvertebrate fauna in the receiving stream. At Holston Army Ammunition Plant, macroinvertebrate populations were adversely affected within 100-200 yards of an outfall containing

munition wastes; the concentration of RDX was up to 700 μg/L in the river water and the concentration of TNT in the sediment was as high as 4.2 mg/kg. At Radford Army Ammunition Plant, bottom fauna in the creek receiving TNT wastewater was reported to be of the pollution-tolerant type. At Iowa Army Munition Plant, benthic diversity was sharply reduced in areas where TNT levels were highest (110.6 mg/kg). At Louisiana Army Ammunition Plant, high levels of stress on macroinvertebrates was associated with TNT levels of <1 to 60 mg/L. At Volunteer Army Ammunition Plant, toxic effects were seen in macroinvertebrates exposed to munition residues up to 345 ppb. High levels of phosphorus reportedly eliminated the invertebrate fauna in the receiving stream at Pine Bluff Arsenal.

Zooplankton - At Volunteer Army Munition Plant, zooplankton abundance was reduced in the water body receiving TNT wastewaters.

Algae/Periphyton - Munition wastewaters can be toxic to freshwater algae. At Badger Army Ammunition Plant, wastewater ponds containing 3 ppm nitroglycerin had depauperate algal communities. At Holston Army Ammunition Plant, periphyton communities were adversely affected by RDX concentrations of 20-100 μg/L. Wastewater discharges at Radford Army Ammunition Plant caused localized damage to the flora of the receiving river; immediately downstream from the burning ground area, the number of species of algae was reduced. At Volunteer Army Ammunition Plant, munition residues in the receiving water body were toxic to periphyton; it was estimated that effects would be minimal if the combined concentration of TNT, 2,4-DNT, and 2,6-DNT did not exceed 20 ppb.

CONCLUSIONS

The biomonitoring studies and ecological surveys that were available for this analysis are limited in number and scope; consequently, any generalizations concerning the potential ecological impacts of operations at U.S. military installations should only be considered as preliminary pending more extensive investigations.

Impacts on terrestrial fauna and flora may occur in the immediate vicinity of land disposal and OB/OD sites, not only as a result of physical destruction of habitat but also due to the presence of toxic residuals in the soil. Onsite waste ponds might also be a source of contamination if used as a source of drinking water for wildlife or if aquatic organisms living in the ponds are used as a food source by wildlife. The magnitude of the contaminant effects on wildlife species can be expected to vary with the population size and degree of spatial and temporal confinement to areas of contamination. Mobile species of larger size that are wide ranging (i.e., deer, fox, raptors) would come into contact with contaminated media less frequently than species of small size with restricted ranges (i.e, invertebrates, reptiles, amphibians, small mammals). In the latter case, burrowing animals would be most susceptible to the effects of contaminated soil, as was demonstrated in one study in which OB soil samples were shown to be toxic to earthworms. Effects of contaminants on small

mammals are difficult to assess in the field because these species are often subject to natural population fluctuations which, as suggested in one study, might be due to increased predation pressure. The presence of large numbers of predatory species would furthermore support the conclusion that adverse effects were not resulting from the bioaccumulation of contaminants through the food chain. However, additional studies on this subject might be warranted particularly for heavy metals, which may be more likely to be taken up by plants and transferred to higher trophic levels.

Motile and nonmotile species might also come into contact with contaminants carried downwind from disposal and OB/OD sites in dusts and smokes. In the case of deer, the level of exposure would be a function of time spent in the plume area, the atmospheric concentrations and degradation rates of the contaminants, the rates of surface deposition on vegetation consumed by the deer, and the rates at which the contaminants are removed from the vegetation by precipitation, wind or other means. The monitoring and survey studies reviewed in this report indicate that, for the contaminants evaluated, the overall effects on resident deer populations appear to be minimal. Although concentrations of heavy metals such as arsenic were found to be elevated in deer tissue collected at two sites, there is no evidence that such levels might be toxic. Additional studies comparing arsenic levels with deer population size, average body weight, and reproductive parameters, would be needed to determine if adverse impacts were occurring on specific segments of the deer population.

Impacts on aquatic fauna and flora are likely to occur in water bodies receiving wastewater effluents, and in surface waters subject to runoff from disposal and OB/OD areas. Only a few of the aquatic studies reviewed in this report examined the impacts of runoff from OB areas; these studies indicate that algae may be more susceptible than macroinvertebrates to runoff contaminants. Point source effluents from ammunition plants appear to be more likely to cause adverse impacts on both aquatic flora and fauna. Observed toxic effects on periphyton, zooplankton, benthic macroinvertebrates, and fish were, in most cases, confined to the disposal ponds or to downstream sections of the receiving water body. The magnitude of the effects on aquatic populations can be expected to vary with the concentration of the contaminants in the effluent and with the physical and chemical characteristics (i.e., temperature, light levels, pH, flow rate) of the receiving stream.

The overall conclusion that can be reached from the studies evaluated in this report is that for terrestrial systems, no large scale ecological impacts have been correlated with land disposal or OB/OD activities on military installations; however, this does not preclude the possibility of very localized effects; including those caused by runoff into nearby streams. Direct releases of munition residues in wastewater effluents have been shown to cause adverse effects on aquatic flora and fauna; however, in most cases such effects are confined to nearby downstream reaches of the receiving stream.

ORNL/TM-12898

MANUAL FOR PC-DATA BASE

SCREENING BENCHMARKS FOR ECOLOGICAL RISK ASSESSMENT

December 1994

Environmental Sciences Division
Health Sciences Research Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Prepared
for

U.S. Department of Energy
Washington, DC

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE
U.S. DEPARTMENT OF ENERGY
Under Contract No. DE-AC05-84OR21400

This database is intended for use in screening-level ecological risk assessments. Although the values have been approved for use in risk assessments performed at U.S. Department of Energy sites operated by Martin Marietta Energy Systems, Inc., they have not been endorsed for general application by any state or federal agency. The values are not intended for use as remedial action goals. For further information on the use of the data base and the methodologies employed in deriving the benchmarks, please contact: Dr. L. Barnthouse, Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6036. Phone: 615 574-7393.

TABLE OF CONTENTS

MANUAL FOR PC-DATA BASE BENCHMARKS FOR ECOLOGICAL RISK ASSESSMENT

1. INTRODUCTION

Risk assessments of waste sites require that contaminants be screened to identify those chemicals that may pose an ecological hazard. A Screening Assessment involves a comparison of the reported environmental levels of the contaminants with toxicological benchmarks derived from laboratory or field data for a particular species or group of organisms. If a chemical concentration or the estimated exposure level is lower than the lowest calculated benchmark, then the chemical is unlikely to represent an ecological risk. However, if the chemical concentration or the reported detection limit exceeds a benchmark, then further analysis is needed to determine what, if any, hazard is posed by that chemical. The more the chemical concentration exceeds its benchmark, the more likely that the contaminant is a problem. Screening benchmarks, therefore, provide a quick way to prioritize contaminants at a particular waste site.

This database consists of four data files containing screening benchmarks for chemical contaminants for four groups of organisms: (1) aquatic biota; (2) terrestrial wildlife (mammals and birds); (3) terrestrial plants; and (4) sediment-associated organisms. The data files vary in size and scope because of the limitations in the basic toxicological data from which benchmarks were derived. The chemicals evaluated in the data files were originally selected from a list of contaminants identified at DOE's Oak Ridge facility. As more information becomes available, the data files will be expanded to include other contaminants.

2. DATA BASE MANAGEMENT SYSTEM

2.1 OPERATING SYSTEM

The Screening Benchmarks Data Base was developed using the FoxPro● data base management system; however, FoxPro is not required on the user's PC to access and search the database. Recommended requirements for operating this data base are an IBM compatible 386 personal computer using DOS 5.0 and a disc drive having 3 MB of available space. All functions in the data base can be performed with keyboard commands. Although a mouse can also be used, it may require setting up a command pathway from the mouse driver.

> NOTE: If you normally have a large number of applications running on your PC, you may get the message "too many files open" during the course of using this data base and you may be automatically exited from the program. If this should happen, we recommend that you enter the CONFIG.SYS file in your DOS directory and increase the number where it says FILES = ___.

2.2 LOADING THE DATA BASE

All the data files and the executable file to run the program are on one diskette (a 3.5 inch diskette version is included). To fit all the files on a single diskette they were compressed into a single file named "bench.zip". The executable file which is used to decompress "bench.zip", is named "pkunzip.exe" and is also on the diskette. To load and decompress the database files on your PC proceed in the following manner (shaded boxes indicate screen display):

1. On your PC's hard drive (usually the C Drive), or any drive having 3 MB of space, create the directory "bench"; i.e, at the C:\> prompt type "md c:\bench"

   EXAMPLE: C:\>md c:\bench then press <ENTER>

2. Insert the diskette into the appropriate Drive (designated as the B Drive in this example, but it may be different on your PC).

3. Go from the C Drive on your PC to the Drive with the diskette:

   EXAMPLE: C:\>b: then press <ENTER>

4. At the B:\> prompt type "pkunzip bench.zip c:\bench"

   EXAMPLE: B:\>pkunzip bench.zip c:\bench then press <ENTER>

   NOTE: It may take several minutes for this operation to be completed

5. When the B:\> prompt returns, go to the C Drive:

   EXAMPLE: B:\>c: then press <ENTER>

Your PC's C Drive should now contain the decompressed Screening Benchmarks Data Base in the directory "bench", and you should be back on the C Drive.

3. SEARCHING THE DATA BASE

3.1 LOGGING ON

1. To access the Data Base, go to the C Drive, or to the drive containing the data base if it is not on the C Drive. Assuming that the data base is on your C Drive:

2. At the C:\> prompt go to the directory "bench"

   EXAMPLE: C:\>cd\bench then press <ENTER>

3. At the C:\bench> prompt type "bench"

EXAMPLE: C:\bench>bench then press <ENTER>

The following title screen should appear.

SCREENING BENCHMARKS
FOR
ECOLOGICAL RISK ASSESSMENT

prepared by

Environmental Sciences Division
Health Sciences Research Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee

for

U.S. Department of Energy,
Washington, DC

Press a Key to Continue...

Pressing any key will continue the program and bring up the following statement:

This database is intended for use in screening-level ecological risk assessments. Although the values have been approved for use in risk assessments performed at U.S. Department of Energy sites operated by Martin Marietta Energy Systems, Inc., they have not been endorsed for general application by any state or federal agency. The values are not intended for use as remedial action goals.

Pressing any key again will bring up the MAIN MENU from which one of the four data files can be selected for searching. NOTE: You can exit the data base at this time by pressing the <Esc> key and then pressing C for Cancel.

3.2 SELECTING A DATA FILE FROM THE MAIN MENU

BENCHMARK FILES
MAIN MENU

1 - Aquatic Biota
2 - Wildlife
3 - Terrestrial Plants
4 - Sediment-associated Organisms
5 - Exit System - Return to the DOS Prompt

Make any selection by pressing the appropriate number key (1, 2, 3, 4 or 5), highlighting the desired topic (menu bar movement with the UParrow or DNarrow) and pressing ENTER. A mouse may be used if a compatible configuration exits.

A data file can be selected from the MAIN MENU in one of the following ways (these are also listed at the bottom of the screen):

1. Press the appropriate number Key (from the keyboard or the number pad).

2. Highlight the desired file by moving the menu bar with the Up-arrow key (↑) or the Down-arrow key (↓), and then press the <ENTER> key.

NOTE: Only one file can be searched at one time; however, more than one file can be searched sequentially during each session by returning to the MAIN MENU and entering another file. The benchmark values selected from different data files will be retained (in separate files) until overwritten during the next session (i.e, when the data base is exited and re-entered).

3.3 SEARCHING FOR A CHEMICAL WITHIN A DATA FILE

When a data file is selected from the MAIN MENU, a SEARCH MENU will appear:

"NAME OF DATA FILE"
SEARCH MENU

1 - Scroll an Ordered List of Compounds
2 - Scroll an Ordered List of CAS Registry Numbers
3 - Search by Typing a Compound Name
4 - Search by Typing a CAS Registry Number
5 - Information about the Selected Data File
6 - Return to MAIN MENU

Make any selection by pressing the appropriate number key (1, 2, 3, 4 or 5), highlighting the desired topic (menu bar movement with the UParrow or DNarrow) and pressing ENTER. A mouse may be used if a compatible configuration exits.

An operation can be selected from this menu in the same manner as that used on the MAIN MENU (these choices are also listed (in abbreviated form) at the bottom of the screen):

1. Press the appropriate number Key (from the keyboard or the number pad).

2. Highlight the desired file by moving the menu bar with the Up-arrow key (↑) or the Down-arrow key (↓) and then press the <ENTER> key.

Searching by CAS Number is recommended because each chemical is listed in the data base only by its most common name, and will not be found if searched for by a chemical synonym.

Item #5 is a brief description of the data file and the benchmarks contained in the file. Similar descriptions are given in Section 4 of this manual.

3.3.1 Scrolling an Ordered List

If this selection is made from the SEARCH MENU, the following screen will appear:

CHEMICAL	CAS No.
ACENAPHTHENE	000083-32-9
ACETONE	000067-64-1
ALUMINUM	007429-90-5
AMMONIA	007664-41-7
ANTHRACENE	000120-12-7
ANTIMONY	007440-36-0
AROCLOR-1221	011104-28-2
AROCLOR-1232	011141-16-5
AROCLOR-1242	053469-21-9
AROCLOR-1248	012672-29-6
AROCLOR-1254	011097-69-1
AROCLOR-1260	011096-82-5

Scroll Bar for Use with a Mouse

( ) Present Data for a Chemical Selected from this List
( ) Return to Previous Menu

Use UpArrow, DnArrow, PgUp, PgDn, etc, to Move Within List. Use <Tab> to Move to and from List or other Menu Choices. Confirm Selection by Pressing <ENTER>.

A chemical can be selected from this alphabetical list in the following manner:

1. If the highlighted Menu Bar is not visible or is on the <Present Data...> option when this screen first appears, press the Down-arrow (↓) repeatedly until it appears at the top of the list.

2. Press the Up-arrow (↑), Down-arrow (↓), Page-up (PgUp), or Page-down (PgDn) key to move the highlighted Menu Bar through the list to the desired chemical. The selected chemical will be marked with a small triangle to the left of the name.

3. Then press the <Tab> key to move the highlighted Menu Bar to the Menu Options listed below the chemical list.

4. With the highlighted Menu Bar on < Present Data...> press the <ENTER> key to bring up the screen with the benchmarks for the marked chemical.

NOTE: Information on only one chemical can be viewed at one time; however, any number of chemicals can be searched sequentially (in the same data file) and the selected benchmarks can be marked and stored together in one file for printing or exporting to another system (see Section 3.4).

3.3.2 Scrolling a List of CAS Registry Numbers

If this selection is made from the SEARCH MENU, the following screen will appear:

CAS No.	CHEMICAL
000050-32-8	BENZO[A]PYRENE
000056-23-5	CARBON TETRACHLORIDE
000057-12-5	CYANIDE
000057-74-9	CHLORDANE
000064-17-5	ETHANOL
000067-56-1	METHANOL
000067-64-1	ACETONE
000067-66-3	CHLOROFORM
000071-43-2	BENZENE
000071-55-6	1,1,1-TRICHLOROETHANE
000075-01-4	VINYL CHLORIDE

Scroll Bar for Use with a Mouse

( ) Present Data for a Chemical Selected from this List
( ) Return to Previous Menu

Use <Tab> to Move to and from List or other Menu Choices.
Confirm Selection by Pressing <ENTER>. Alternately, the Mouse may be Used.

A chemical can be selected from this numeric list in the following manner:

1. If the highlighted Menu Bar is not visible or is on the <Present Data...> option when this screen first appears, press the Down-arrow (↓) repeatedly until it appears at the top of the list.

2. Press the Up-arrow (↑), Down-arrow (↓), Page-up (PgUp), or Page-down (PgDn) key to move the highlighted Menu Bar through the list to the desired chemical. The selected chemical will be marked with a small triangle to the left of the name.

3. Then press the <Tab> key to move the highlighted Menu Bar to the Menu Options listed below the CAS No. list.

4. With the highlighted Menu Bar on < Present Data...> press the <ENTER> key to bring up the screen with the benchmarks for the marked chemical.

NOTE: Information on only one chemical can be viewed at one time; however, any number of chemicals can be searched sequentially (in the same data file) and the selected benchmarks can be marked and stored together in one file for printing or exporting to another system (see Section 3.4).

3.3.3 Searching by Chemical Name

If this selection is made from the SEARCH MENU, the following screen will appear:

```
"NAME OF DATA FILE" - CHEMICAL NAME SEARCH

Enter a Chemical Name  _______________

Some Examples of Chemical Names:
                AROCLOR-1254
                N-NITROSO-DI-N-PROPYLAMINE
                SELENIUM
                TRICHLOROETHANE, 1,1,1-
Name Will Appear in Upper Case.  Confirm by Pressing <ENTER>
```

If the chemical is not in the data base, a message to that effect will appear. Press any key to return to the SEARCH MENU. Only the most common name of each chemical is listed in the data base, therefore, searching on the CAS Number is recommended.

3.3.4 Searching by CAS Number

If this selection is made from the SEARCH MENU, the following screen will appear:

```
"NAME OF DATA FILE" - CAS NUMBER SEARCH

Enter a CAS Number  ______-__-_

Examples of Valid Chemical Abstracts
Service (CAS) Registry Numbers:

  000067-64-1    000768-49-0
  025154-55-6    105906-36-3

Supply Leading Zeros.  Confirm by Pressing <ENTER>
```

If the chemical is not in the data base, a message to that effect will appear. Press any key to return to the SEARCH MENU.

3.4 SELECTING BENCHMARKS

When a chemical is selected by any of the methods outlined above, a list of the screening benchmarks for that chemical will appear. The format in which benchmark values are presented will vary depending on the data file accessed. Each of these formats is described below.

3.4.1 Benchmarks for Aquatic Biota

When a chemical is selected in this data file, the following type of screen will appear.

Benchmarks for Aquatic Biota			
Cyanide CASRN 000012-25-5			
---- Values Shown are in Micrograms Per Liter ----			
Pick	F	Bench	Source
N		5.2	National Ambient Water Quality Criterion - Chronic
N		22	National Ambient Water Quality Criterion - Acute
N		-	Secondary Acute Value
N		-	Secondary Chronic Value
N		7.8	Lowest Chronic Value - Fish
N		-	Lowest Chronic Value - Daphnids
N		18.33	Lowest Chronic Value - Nondaphnid invertebrates

Move to a Benchmark Using the UpArrow or DnArrow Key. Select that Benchmark by Entering a Y Under Pick or Deselect with a N. Then press <Esc>.

The fields shown on this screen are described below:

Pick: This field is used to mark one or more benchmarks for printing or exporting to a storage file.

F: A " > " or " < " symbol will appear in this field if the calculated or estimated benchmark is greater than or less than the value shown.

Bench: The value shown is the calculated or estimated benchmark in µg/L.

Source: This field identifies the criterion, effect or endpoint that the benchmark value represents (descriptions and definitions are given in Section 4.1).

NOTE: When a National Ambient Water Quality Criterion - Chronic is not available for a given chemical, the Secondary Chronic Value should be considered the regulatory equivalent value (see Section 4.1).

TO SELECT A BENCHMARK:

1. Press the Up-arrow (↑) or Down-arrow (↓) to move the highlighted Menu Bar through the list. NOTE: All the available benchmarks may not be shown. Move the Menu Bar with the Down-arrow to the bottom of the list and continue to reveal any additional values.

2. With the highlighted Menu Bar on the line containing a desired benchmark, press the Y key to mark the benchmark. Repeat sequence for other benchmarks (press N to deselect a benchmark). Then press the <Esc> key to reveal the following menu:

   < Review selected information>
   < Send selected Info to a Printer>
   < Send selected Info to a File>
   < Return to Previous Menu>
   < Exit--Return to DOS>

Press the Up-arrow (↑) or Down-arrow (↓) to move the highlighted Menu Bar through this list to the option desired, and then press <ENTER>. These options are described below:

1. Review selected information. After benchmark values for several chemicals are marked, they can be re-examined. If this option is chosen, the following type of screen will appear:

Benchmarks for Aquatic Biota				
— Values Shown are in Micrograms Per Liter —				
Pick	Chemical	F	Bench	Source
Y	Cyanide		5.2	National Ambient Water Quality - Chron
Y	DDT		0.008	Sensitive Species Test EC20
Y	Heptachlor		1.26	Lowest Chronic Value - Fish

< Review selected information>
< Send selected Info to a Printer>
< Send selected Info to a File>
< Return to Previous Menu>
< Exit--Return to DOS>

Move to a Benchmark Using the UpArrow or DnArrow Key. Deselect a Benchmark by Entering a N Under Pick. Then press <Esc>.

NOTE: Individual benchmarks can be deleted by entering an N in the Pick field. Movement of the cursor is controlled by the Right-arrow, Left-arrow, and <Tab> keys, and can be used to read the entire Source name if it is not shown. Press the <Esc> key to return to the Menu Options.

2. Send selected Information to a Printer. If this option is chosen, the CAS No., chemical name, benchmark value and type of benchmark for the selected chemicals will be printed. An example of the print format is shown below:

```
000057-12-5   CYANIDE  (values shown are in micrograms per liter)

22   NATIONAL AMBIENT WATER QUALITY CRITERION - ACUTE
5.2  NATIONAL AMBIENT WATER QUALITY CRITERION - CHRONIC
7.8  LOWEST CHRONIC VALUE - FISH
5.3  LOWEST TEST EC20 - FISH
1.17 SENSITIVE SPECIES TEST EC20
11   POPULATION EC20

000050-29-3   DDT

0.04     SECONDARY CHRONIC VALUE
0.008    SENSITIVE SPECIES TEST EC20
```

3. Send selected Information to a File. If this option is chosen, the following screen will appear:

```
Please Select a File Format to Receive Information

<Data Interchange Format>
<Lotus 1-2-3>
<Lotus Symphony>
<Microsoft Excel>
<ASCII>
```

To select one of these file formats move the MENU BAR with the Up-arrow (↑) or Down-arrow (↓) key to the desired format and then press <ENTER>. Default file names are shown below:

<Data Interchange Format>	AQ_DIF.DIF
<Lotus 1-2-3>	AQ_123.WK1
<Lotus Symphony>	AQ_SYMPH.WR1
<Microsoft Excel>	AQ_EXCEL.XLS
<ASCII>	AQUATIC.TXT

A screen will then appear indicating that the file already exists and giving the file name. Press Y to save the data in the file. A confirmation message will appear; then press <Esc> to return to the previous menu. NOTE: The data in these files will be overwritten when a new data set is sent to the same file format; therefore, for permanent storage the data should be transferred to another file.

4. Return to Previous Menu. This option is used to search for another chemical in the same data file.

5. <Exit--Return to DOS>. This option is used to end a search session.

3.4.2 Benchmarks for Wildlife

When a chemical is selected in this data file, the following type of screen will appear:

WILDLIFE				
TOLUENE CASRN 000108-88-3				
Pick	Species	NOAEL	FoodConc	WaterConc
N	Rat (test species)	25.98	0.00	00.0
N	Short-tailed shrew	32.657	54.429	148.441
N	Little brown bat	41.050	123.151	256.566
N	White-footed mouse	28.780	186.223	95.933
N	Meadow vole	22.895	201.479	167.900
N	Cottontail rabbit	7.691	38.94	79.558
N	Mink	8.168	59.617	82.501
N	Red Fox	4.972	49.721	58.880
N	Whitetail deer	2.157	70.053	32.944

NOAEL - mg/kg/day
FOOD - ppm
WATER - ppm

Move to a Benchmark Using the UpArrow or DnArrow Key. Select that Benchmark by Entering a Y Under Pick or Deselect with a N. Then press <Esc>.

The fields shown on this screen are described below:

Pick: This field is used to mark one or more benchmarks for printing or exporting to a storage file.

Species: This field gives the common name of the species for which the benchmarks were calculated.

NOAEL: The NOAEL is the No-Observed-Adverse-Effect-Level. NOAELs for the test species were derived from laboratory data, and were used to calculate NOAELs for the wildlife species (see Section 4.2 for derivation).

FoodConc: Food Concentration is the dietary level (in ppm) that would be expected to result in an intake equivalent to the estimated NOAEL.

WaterConc: Water concentration is the drinking water level (in ppm) that would be expected to result in an intake equivalent to the estimated NOAEL.

NOTE: For metal salts, the benchmarks are given in terms of dose or concentration of the metal or metal ion and not the concentration of chemical compound in which it occurs.

TO SELECT A BENCHMARK:

1. Press the Up-arrow (↑) or Down-arrow (↓) to move the highlighted Menu Bar through the list. **NOTE:** All the available benchmarks may not be shown. Move the Menu Bar with the Down-arrow to the bottom of the list and continue to reveal any additional values.

2. With the highlighted Menu Bar on the line containing a desired benchmark, press the Y key to mark the benchmark. Repeat sequence for other benchmarks (press N to deselect a benchmark). Then press the <Esc> key to reveal the following menu:

   < Review selected information>
   < Send selected Info to a Printer>
   < Send selected Info to a File>
   < Return to Previous Menu>
   < Exit--Return to DOS>

Press the Up-arrow (↑) or Down-arrow (↓) to move the highlighted Menu Bar through this list to the option desired, and then press <ENTER>. These options are described below:

1. Review selected information. After benchmark values for several chemicals are marked, they can be re-examined. If this option is chosen, the following type of screen will appear:

Benchmarks for Wildlife

Pick	Chemical	Species	NOAEL	FoodConc	WaterConc
Y	Vinyl chloride	White-footed mouse	0.424	2.741	1.412
Y	Xylenes (mixed)	Red fox	0.394	3.942	4.669
Y	DDT	Red-tailed hawk	0.00041	0.00051	0.00721

< Review selected information>
< Send selected Info to a Printer>
< Send selected Info to a File>
< Return to Previous Menu>
< Exit--Return to DOS>

NOAEL - mg/kg/day
Food - ppm
Water - ppm

Move to a Benchmark Using the UpArrow or DnArrow Key. Deselect that Benchmark by Entering a N Under Pick. Then press <Esc>.

NOTE: Individual benchmarks can be deleted by entering an N in the Pick field. Movement of the cursor is controlled by the Right-arrow, Left-arrow, and <Tab> keys, and can be used to read the entire chemical name if it is not shown. Press the <Esc> key to return to the Menu Options.

2. Send selected Information to a Printer. If this option is chosen, the CAS No., chemical name, species, and benchmark value for the selected chemicals will be printed. An example of the print format is shown below:

015502-74-6 ARSENITE	NOAEL (mg/kg/day)	FOODCONC (ppm)	WATERCONC (ppm)
Cottontail rabbit	0.037	0.189	0.386
Whitetail deer	0.010	0.340	0.160
000067-64-1 ACETONE			
Red fox	4.305	43.051	50.981
000057-74-9 CHLORDANE			
American robin	2.013	1.667	14.625

3. Send selected Information to a File. If this option is chosen the following screen will appear:

Please Select a File Format to Receive Information

<Data Interchange Format>
<Lotus 1-2-3>
<Lotus Symphony>
<Microsoft Excel>
<ASCII>

To select one of these file formats move the MENU BAR with the Up-arrow (↑) or Down-arrow (↓) key to the desired format and then press <ENTER>. Default file names are shown below:

<Data Interchange Format>	WL_DIF.DIF
<Lotus 1-2-3>	WL_123.WK1
<Lotus Symphony>	WL_SYMPH.WR1
<Microsoft Excel>	WL_EXCEL.XLS
<ASCII>	WILDLIFE.TXT

A screen will then appear indicating that the file already exists and giving the file name. Press Y to save the data in the file. A confirmation message will appear; then press <Esc> to return to the previous menu. NOTE: The data in these files will be overwritten when a new data set is sent to the same file format; therefore, for permanent storage the data should be transferred to another file.

4. Return to Previous Menu. This option is used to search for another chemical in the same data file.

5. <Exit--Return to DOS>. This option is used to end a search session.

3.4.3 Benchmarks for Terrestrial Plants

When a chemical is selected in this data file, the following type of screen will appear.

TERRESTRIAL PLANTS			
ALUMINUM CASRN 007429-90-5			
Pick	Bench	Medium	Reference
N	50	Soil	
N	0.2	Solution	

Soil -- mg/kg
Solution -- mg/L

Move to a Benchmark Using the UpArrow or DnArrow Key. Select that Benchmark by Entering a Y Under Pick or Deselect with a N. Then press <Esc>.

The fields shown on this screen are described below:

Pick: This field is used to mark a benchmark for printing or exporting to a storage file.

Bench: The reported benchmark values in mg/kg soil and mg/L water (see Section 4.3 for derivation of values).

Medium: The test medium, soil or aqueous solution, which was used to develop the benchmark value.

Reference: The data source for the benchmark value.

TO SELECT A BENCHMARK:

1. Press the Up-arrow (↑) or Down-arrow (↓) to move the highlighted Menu Bar through the list.

2. With the highlighted Menu Bar on the line containing a desired benchmark, press the Y key to mark the benchmark. Repeat sequence for other benchmarks (press N to deselect a benchmark). Then press the <Esc> key to reveal the following menu:

   < Review selected information>
   < Send selected Info to a Printer>
   < Send selected Info to a File>
   < Return to Previous Menu>
   < Exit--Return to DOS>

Press the Up-arrow (↑) or Down-arrow (↓) to move the highlighted Menu Bar through this list to the option desired, and then press <ENTER>. These options are described below:

1. Review selected information. After benchmark values for several chemicals are marked, they can be re-examined. If this option is chosen, the following type of screen will appear:

Benchmarks for Terrestrial Plants			
Pick	Chemical	Bench	Medium
Y	Arsenic	10	Soil
Y	Arsenic	0.001	Solution
Y	PCB	40	Soil

< Review selected information > Soil - mg/kg
< Send selected Info to a Printer > Solution - mg/L
< Send selected Info to a File >
< Return to Previous Menu>
< Exit -- Return to DOS >

Move to a Benchmark Using the UpArrow or DnArrow Key. A Benchmark can be Deselected by Entering a N Under Pick. Then press <Esc>.

NOTE: Individual benchmarks can be deleted by entering an N in the Pick field. Movement of the cursor is controlled by the Right-arrow, Left-arrow, and <Tab> keys, and can be used to read the entire chemical name if it is not shown. Press the <Esc> key to return to the Menu Options.

2. Send selected Information to a Printer. If this option is chosen, the CAS No., chemical name, benchmark value and medium for the selected chemicals will be printed. An example of the print format is shown below:

```
007440-48-4   COBALT
20   mg/kg    SOIL      LINZON, 1978
0.06 mg/L     SOLUTION

007440-36-0   ANTIMONY
5    mg/kg    SOIL

000084-74-2   DI-N-BUTYL PHTHALATE
```

3. Send selected Information to a File. If this option is chosen the following screen will appear:

```
Please Select a File Format to Receive Information

<Data Interchange Format>
<Lotus 1-2-3>
<Lotus Symphony>
<Microsoft Excel>
<ASCII>
```

To select one of these file formats move the MENU BAR with the Up-arrow (↑) or Down-arrow (↓) key to the desired format and then press <ENTER>. Default file names are shown below:

<Data Interchange Format>	PL_DIF.DIF
<Lotus 1-2-3>	PL_123.WK1
<Lotus Symphony>	PL_SYMPH.WR1
<Microsoft Excel>	PL_EXCEL.XLS
<ASCII>	PLANT.TXT

A screen will then appear indicating that the file already exists and giving the file name. Press Y to save the data in the file. A confirmation message will then appear, then press the <Esc> key to return to the previous menu. NOTE: The data in these files will be overwritten when a new data set is sent to the same file format; therefore, for permanent storage the data should be transferred to another file.

4. Return to Previous Menu. This option is used to search for another chemical in the same data file.

5. <Exit--Return to DOS>. This option is used to end a search session.

3.4.4 Sediment-associated organisms

When a chemical is selected in this data file, the following type of screen will appear:

SEDIMENT-ASSOCIATED ORGANISMS		
ANTIMONY CASRN 007440-36-0		
Pick	Bench	Endpoint
N	2	Effects Range-Low (NOAA)
N	25	Effects Range-Median (NOAA)

Values in mg/kg dry wt.

Move to a Benchmark Using the UpArrow or DnArrow Key. Select that Benchmark by Entering a Y Under Pick or Deselect with a N. Then press <Esc>.

The fields shown on this screen are described below:

Pick: This field is used to mark a benchmark for printing or exporting to a storage file.

Bench: The calculated or estimated benchmark value in mg/kg dry weight.

Endpoint: The benchmarks included in this data file are: (1) Effects Range- Low (NOAA); (2) Effects Range - Median (NOAA); (3) EPA Sediment Quality Criterion for 1% organic carbon (EPA); (4) Estimated Equivalent Sediment Quality Criterion for 1% organic carbon; (5) Apparent Effects Threshold; (6) Sediment Quality Value (State of Washington); (7) Lowest Effect Level (Ontario Ministry of the Environment); (8) Sediment Classification Guideline (EPA Region V) (see Section 4.4 for descriptions of endpoints).

TO SELECT A BENCHMARK:

1. Press the Up-arrow (↑) or Down-arrow (↓) to move the highlighted Menu Bar through the list.

2. With the highlighted Menu Bar on the line containing a desired benchmark, press the Y key to mark the benchmark. Repeat sequence for other benchmarks (press N to deselect a benchmark). Then press the <Esc> key to reveal the following menu:

   < Review selected information>
   < Send selected Info to a Printer>
   < Send selected Info to a File>
   < Return to Previous Menu>
   < Exit--Return to DOS>

Press the Up-arrow (↑) or Down-arrow (↓) to move the highlighted Menu Bar through this list to the option desired, and then press <ENTER>. These options are described below:

1. Review selected information. After benchmark values for several chemicals are marked, they can be re-examined. If this option is chosen, the following type of screen will appear:

Benchmarks for Sediments			
Pick	Chemical	Bench	Endpoint
Y	Antimony	2	Effects Range-Low (NOAA)
Y	Copper	34	Effects Range-Low (NOAA)
Y	Copper	270	Effects Range-Median (NOAA)

< Review selected information>   Values in mg/kg dry wt.
< Send selected Info to a Printer>
< Send selected Info to a File>
< Return to Previous Menu>
< Exit--Return to DOS>

Move to a Benchmark Using the UpArrow or DnArrow Key. A Benchmark can be Deselected by Entering a N Under Pick. Then press <Esc>.

NOTE: Individual benchmarks can be deleted by entering an N in the Pick field. Movement of the cursor is controlled by the Right-arrow, Left-arrow, and <Tab> keys, and can be used to read the entire chemical name if it is not shown. Press the <Esc> key to return to the Menu Options.

2. Send selected Information to a Printer. If this option is chosen, the CAS No., chemical name, benchmark value and endpoint for the selected chemicals will be printed. An example of the print format is shown below:

```
007440-36-0    ANTIMONY (values shown are in ppb)
2    Effects Range-Low

007440-50-8    COPPER
34 Effects Range-Low
270 Effects Range-Median
```

3. Send selected Information to a File. If this option is chosen the following screen will appear:

```
Please Select a File Format to Receive Information

<Data Interchange Format>
<Lotus 1-2-3>
<Lotus Symphony>
<Microsoft Excel>
<ASCII>
```

To select one of these file formats move the MENU BAR with the Up-arrow (↑) or Down-arrow (↓) key to the desired format and then press <ENTER>. Default file names are shown below:

<Data Interchange Format>	SD_DIF.DIF
<Lotus 1-2-3>	SD_123.WK1
<Lotus Symphony>	SD_SYMPH.WR1
<Microsoft Excel>	SD_EXCEL.XLS
<ASCII>	SEDIMENT.TXT

A screen will then appear indicating that the file already exists and giving the file name. Press Y to save the data in the file. A confirmation message will then appear, then press <Esc> key to return to the previous menu. NOTE: The data in these files will be overwritten when a new data set is sent to the same file format; therefore, for permanent storage the data should be transferred to another file.

4. Return to Previous Menu. This option is used to search for another chemical in the same data file.

5. <Exit--Return to DOS>. This option is chosen to exit the entire data base.

4. DESCRIPTION OF DATA FILES

The four data files and benchmarks contained therein are briefly described in this section. A more detailed discussion of each data file and the methods by which the benchmarks were derived is given in four ORNL reports, the citations for which are given at the end of each of the following sections. These reports can be ordered through NTIS.

4.1 AQUATIC BIOTA (see Suter and Mabrey, 1994)

This data file contains potential screening benchmarks for freshwater organisms. The only currently recognized benchmark values for aquatic risk assessment are EPA's acute and chronic **National Ambient Water Quality Criteria** (NAWQC). NAWQC were not designed for contaminant screening; however, because they are Applicable and Relevant or Appropriate Requirements (ARARs) for site clean-ups, any chemical that exceeds its NAWQC must be considered a contaminant of concern. Because screening benchmarks should provide a high degree of confidence that a chemical is not hazardous, greater conservatism then that given by the NAWQC may be warranted. Therefore, alternative screening benchmarks, based on different conceptual approaches to estimate concentrations causing significant effects were developed and are included in this data file. These alternative screening benchmarks include the following :

Tier 2 secondary acute and chronic values. Tier 2 values were developed based on the method described in EPA's Proposed Water Quality Guidance for the Great Lakes System. This method allows for the derivation of benchmarks (equivalent to final acute values and final chronic values) with fewer data points than the number required for NAWQC. Tier 2 values presented in this data base are concentrations that would be expected to be higher than the NAWQC in no more than 20% of the cases (see Suter et al., 1994 for detailed discussion).

National ambient water quality final chronic value. For chlordane, the NAWQC derived by EPA is based on the final residue value; however, in order to have a benchmark for effects on aquatic organisms rather than piscivorous wildlife (which have a separate set of benchmarks), the final chronic value for chlordane derived by EPA is also included in the data file.

Lowest chronic value - fish. This value is the lowest concentration reported in the literature to be a threshold for statistically significant chronic toxicity in fish, and it is used by the EPA as equivalent to a chronic NAWQC when data are insufficient for deriving a NAWQC or a final chronic value.

Estimated lowest chronic value - fish. This value was estimated by ORNL staff by extrapolation from 96-hr LC_{50} values for fish when no measured chronic values were available for fish.

Lowest chronic value - daphnids. This value is the lowest concentration reported in the literature to be the threshold for statistically significant chronic toxicity to daphnids. It has been used by the EPA as equivalent to a chronic NAWQC when data are insufficient to derive a NAWQC, Tier 2 SCV, or a final chronic value.

Estimated lowest chronic value - daphnids. This value was estimated by ORNL staff by extrapolation from 48-hr LC_{50} values for daphnids when no measured chronic values were available.

Lowest chronic value - nondaphnid invertebrates. This value is the lowest concentration reported in the literature to be the threshold for statistically significant chronic toxicity to aquatic invertebrates other than daphnids.

Lowest chronic value - aquatic plants. This value is the lowest concentration reported in the literature to be the threshold for biologically important toxicity to aquatic plants, in a test of at least 96-hr duration.

Lowest test EC_{20} - fish. This test endpoint, developed by ORNL, is the highest tested concentration of a chemical that caused less than a 20% reduction in (1) weight of young fish per initial female fish in a partial or full life cycle test or (2) the weight of young per egg in an early life-stage test.

Estimated lowest test EC_{20} - fish. This value was extrapolated from 96-h LC_{50} data by ORNL staff.

Lowest test EC_{20} - daphnids. This test endpoint, developed by ORNL staff, is the highest tested concentration of a chemical that caused less than a 20% reduction in the product of growth, fecundity, and survivorship in a chronic test with a daphnid species.

Sensitive species test EC_{20}. This screening benchmark was developed by ORNL staff, and is calculated in the same way as the chronic National Ambient Water Quality Criteria (i.e., the fifth percentile of the species sensitivity distribution) except that the test EC_{20} values are used in place of chronic values.

Population EC_{20}. This value, developed as a screening benchmark by ORNL staff, is an estimate of the continuous (chronic) concentration that would cause a 20% reduction in the recruit abundance of largemouth bass.

Within the Aquatic Biota data file, the chronic NAWQCs and the Secondary Chronic Values (SCV) are regulatory standards or equivalents, and any chemical concentration that exceeds them is clearly of potential concern. [Note: in the case of di-n-octylphtalate, neither a chronic NAWQC nor a SCV is available; therefore, the lowest chronic value, which for this chemical is for daphnids, should be considered the regulatory equivalent value].

It is recommended that ambient chemical concentrations be compared to all the listed benchmarks. If the NAWQC or SCV are not exceeded but other benchmarks are, contaminants of concern should be selected on the basis of the number of benchmarks exceeded and the conservatism of the particular benchmark values exceeded.

References:

Suter, G. W. II, and J. B. Mabrey. 1994. Toxicological Benchmarks for Screening of Potential Contaminants of Concern for Effects on Aquatic Biota on Oak Ridge Reservation, Oak Ridge, Tennessee: 1994 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-96/R1.

4.2 WILDLIFE (see Opresko et al., 1994)

This data file contains screening benchmarks for chemical contaminants which may be of concern at DOE's Oak Ridge site. The benchmarks presented in this file are values believed to be nonhazardous for the listed wildlife species. Eight species of mammals (short-tailed shrew, little brown bat, white-footed mouse, meadow vole, cottontail rabbit, mink, red fox, and whitetail deer) and nine species of birds (American robin, American woodcock, wild turkey, belted kingfisher, great blue heron, barred owl, barn owl, Cooper's hawk, and red-tailed hawk) are included in the data file. The selected species are representative of the fauna occurring at the OR site; however, the assumption is that the benchmarks would be applicable to similar species of similar body size at other sites. Exceedence of the benchmarks does not indicate any particular level or type of risk. Concentrations below the benchmarks are not expected to result in significant effects, particularly in those cases where the supporting data is based on multigeneration reproductive toxicity studies.

The general method that was used in estimating these screening benchmarks is based on EPA methodology for deriving human toxicity values (e.g., Reference Values, Reportable Quantities, and unit risks for carcinogenicity) from laboratory animal data. NOAELs (no-observed-adverse-effect levels) and/or LOAELs (lowest-observed-adverse-effect levels) were identified from studies conducted primarily on laboratory rodents. The equivalent NOAEL for a particular species of wildlife ($NOAEL_w$) was obtained by scaling the laboratory data ($NOAEL_t$) on the basis of differences in body size according to the following equation:

$$NOAEL_w = NOAEL_t \left(\frac{bw_t}{bw_w}\right)^{1/4} \qquad (1)$$

In cases where only a LOAEL was available, the NOAEL was estimated as being equivalent to 1/10th of the LOAEL. If the only available data consisted of a NOAEL (or a LOAEL) for a subchronic exposure (approximately 3 months to 1 yr), then the equivalent NOAEL or LOAEL for a chronic exposure was estimated as being 1/10th of the value for the subchronic exposure.

The dietary level, or concentration in food (C_f, in mg/kg food) which would result in a dose equivalent to the NOAEL (assuming no other exposure through other environmental media) was calculated from the food factor f, which is the amount of food consumed per unit body weight per day:

$$C_f = \frac{NOAEL_w}{f} \qquad (2)$$

Food factors for species of wildlife were derived from the rate of food consumption (F, in g/day or kg/day) and the body weight (bw, in g or kg):

$$f = \frac{F}{bw} \tag{3}$$

In the absence of empirical data, rates of food consumption (F, in kg/day) for laboratory mammals can be estimated from allometric regression models based on body weight (in kg) (EPA, 1988a):

$$F = 0.056(bw)^{0.6611} \quad (laboratory\ mammals) \tag{4}$$

$$F = 0.054(bw)^{0.9451} \quad (moist\ diet) \tag{5}$$

$$F = 0.049(bw)^{0.6087} \quad (dry\ diet) \tag{6}$$

In the absence of specific information on the body weights of the test animals, EPA uses default values (EPA, 1985). F was estimated using Equation 4 and the EPA's default body weights (0.35 kg for rats and 0.03 kg for mice). Reference body weights for particular strains of laboratory animals, and for specific age groups corresponding to subchronic or chronic exposures are available (EPA, 1988a) and these can also be used in the equations. Default values for food consumption and food factors for common laboratory species (rats, mice, dogs, rabbits, etc.) have also been used by EPA (1985, 1988b) for estimating equivalent dose levels for laboratory studies in which the exposure was reported only as a dietary concentration. Generally, the rates of food consumption for laboratory species as derived from Equations 4 are higher then the EPA default values.

Food consumption rates are available for some species of wildlife (EPA, 1993). In the absence of experimental data, F values (g/day) can be estimated from allometric regression models based on metabolic rate and expressed in terms of body weight (g) (Nagy, 1987):

$$F = 0.235(bw)^{0.822} \quad (placental\ mammals) \tag{7}$$

$$F = 0.621(bw)^{0.564} \quad (rodents) \tag{8}$$

$$F = 0.577(bw)^{0.727} \quad (herbivores) \tag{9}$$

$$F = 0.492(bw)^{0.673} \quad (marsupials) \tag{10}$$

$$F = 0.648(bw)^{0.651} \quad (birds) \tag{11}$$

$$F = 0.398(bw)^{0.850} \quad (passerine\ birds) \tag{12}$$

The concentration of the contaminant in the drinking water of an animal (C_w, in mg/L) resulting in a dose equivalent to a $NOAEL_w$ can be calculated from the daily water consumption rate (W, in L/day) and the average body weight (bw_w) for the species:

$$C_w = \frac{NOAEL_w \; x \; bw_w}{W} \tag{13}$$

If known, the water factor ω (= the rate of water consumption per unit body weight (W/bw) can be used in a manner identical to that for the food factor.

$$C_w = \frac{NOAEL_w}{\omega} \tag{14}$$

If empirical data are not available, W (in L/day) can be estimated from allometric regression models based on body weight (in kg) (EPA, 1988a):

$$W = 0.10(bw)^{0.7377} \quad (laboratory\ mammals) \tag{15}$$

$$W = 0.009(bw)^{1.2044} \quad (mammals,\ moist\ diet) \tag{16}$$

$$W = 0.093(bw)^{0.7584} \quad (mammals,\ dry\ diet) \tag{17}$$

In the absence of specific information on the body weights of the test animals, EPA uses default values (see EPA, 1985). W was estimated using Equation 15 and the default body weights. Reference body weights for particular strains of laboratory animals, and for specific age groups corresponding to subchronic or chronic exposures are available (EPA, 1988a) and these can also be used in the equations. Default values for water consumption and ω for common laboratory species

have been used by EPA (1985, 1988b) for estimating equivalent dose levels for laboratory studies in which the exposure was given only as a concentration in the animals' drinking water. Generally, the rates of water consumption for laboratory species as derived from Equations 15 are higher then the EPA default values.

Water consumption rates are available for some species of mammalian wildlife (see EPA, 1993). Water consumption rates (in L/day) can also be estimated from allometric regression models based on body weight (in kg) (Calder and Braun, 1983):

$$W = 0.099(bw)^{0.90} \tag{18}$$

A similar model has also been developed for birds (Calder and Braun, 1983):

$$W = 0.059(bw)^{0.67} \tag{19}$$

References:

Calder, W.A. and E.J. Braun. 1983. Scaling of osmotic regulation in mammals and birds. Am. J. Physiol. 224: R601-R606.

EPA (U.S. Environmental Protection Agency). 1985. *Reference Values for Risk Assessment*. Prepared by Syracuse Research Corporation, Syracuse, NY for Environmental Criteria and Assessment Office, Cincinnati, OH.

EPA (U. S. Environmental Protection Agency). 1988a. *Recommendations for and Documentation of Biological Values for Use in Risk Assessment*. ECAO-CIN-554. Final Draft. Environmental Criteria and Assessment Office, Cincinnati, OH.

EPA (U. S. Environmental Protection Agency). 1988b. *Methodology for Evaluating Potential Carcinogenicity in Support of Reportable Quantity Adjustments Pursuant to CERCLA Section 102*. OHEA-C-073, External Review Draft. Office of Health and Environmental Assessment, Washington, D.C.

EPA (U.S. Environmental Protection Agency). 1993. *Wildlife Exposure Factors Handbook*. EPA/600/R-93/187a. Office of Research and Development, Washington, DC.

Nagy, K.A. 1987. Field and metabolic rate and food requirement scaling in mammals and birds. Ecol. Monogr. 57:111-128

Opresko, D.M., B.E. Sample and G.W Suter II. 1994. Toxicological Benchmarks for Wildlife: 1994 Revision. Oak Ridge National Laboratory, Oak Ridge, TN ES/ER/TM-86/R1.

4.3 TERRESTRIAL PLANTS (see Will and Suter, 1994)

This data file contains potential screening benchmarks for terrestrial plants. There are currently no promulgated benchmark values for terrestrial plants. The general method that was used in estimating these screening benchmarks is based on the National Oceanographic and Atmospheric Administrations's (NOAA) method for deriving the Effects Range Low (ER-L) which has been recommended as a sediment screening benchmark by EPA Region IV. The ER-L is the tenth percentile of the distribution of the various toxic effects thresholds for various organisms in sediments.

The toxic effect endpoint that we used for plants was the lowest observed effect concentration (LOEC), defined here as the lowest applied concentration of the chemical that gave a greater than 20% reduction in a measured response. In some cases, the LOEC for the test was the lowest concentration tested (LCT) or the only concentration tested. Twenty percent reduction in plant growth or yield was used as the threshold for significant effects to be consistent with other screening benchmarks for ecological risk assessment and with current regulatory practice.

The benchmarks for terrestrial plants were derived by rank ordering the LOEC values and then picking a number that approximated the tenth percentile. Statistical fitting was not used because there was seldom sufficient data and because these benchmarks are to be used as screening values and do not require the consistency and precision of regulatory criteria. If there were 10 or fewer values for a chemical, the lowest LOEC was used. If there were more than 10 values, the tenth percentile LOEC value was used. If the tenth percentile fell between LOEC values, a value was chosen by interpolation. In all cases, benchmark values were rounded to one significant figure.

Another possible source of benchmark values is values recommended in published reviews of the phytotoxicity literature. When primary literature is unavailable for a particular contaminant, concentrations identified in reviews as thresholds for phytotoxicity are used as benchmarks. In addition, when fewer than three LOEC values were found for a chemical, and a toxicity threshold from a review was lower than the lowest LOEC, the toxicity threshold was used as the benchmark for that chemical.

The benchmarks reported here were divided into two categories based on the type of rooting medium used in the toxicity tests; soil or solution.

Soil - Tests conducted in natural soils are assumed to be representative of the exposure of plants to contaminants measured in field soils. Soil benchmarks are based on data provided only by toxicity studies in either the field or pots. Most of the soil concentrations of metals reported from waste sites are from extractions with hydrochloric acid (HCl) or other mineral acids which are intended to provide total concentrations. Similarly, concentrations of organic contaminants in waste site soils are total concentrations derived from rigorous solvent extractions. In some cases, toxicity tests report concentrations extracted from contaminated soils, but various extractants are used that may not yield total concentrations. More commonly, the concentrations reported are nominal concentrations of a soluble form (i.e., a highly bioavailable form) of the chemical added to soil.

Solution - Tests conducted in nutrient solutions are assumed to be representative of exposures of plants to contaminants measured in soil solutions (e.g., from lysimeter samples or possibly from aqueous extracts of soil) or in very shallow groundwater (e.g., plants in the vicinity of seeps and springs). Solution benchmarks include data from toxicity tests conducted using whole plants rooted in aqueous nutrient solutions. Tests are commonly conducted in this manner because plants are assumed to be exposed to contaminants in the solution phase of soil and the presence of soil in test systems reduces the experimenter's degree of control over exposure. Groundwater samples from waste sites are typically acidified before analysis to obtain total concentrations, but some samples are filtered before acidification.

NOTE: These benchmarks are to serve for contaminant screening only. Plant toxicity may be affected by many variables: pH, Eh, cation exchange capacity, moisture content, interactions with other elements, and organic matter and clay content of the soil. In addition, different species react to different contaminants with varying degrees of toxicity, and the sensitivity of plants may be affected by their physiological condition. No systematic tests that thoroughly examine the effects of these variables on plant toxicity are known to these authors. An assessor must realize that these soil characteristics play a large part in plant toxicity and incorporate these site-specific considerations in the evaluation of the potential hazards of a chemical. If chemical concentrations reported in field soils that support vigorous and diverse plant communities exceed one or more of the benchmarks presented in this report or if a benchmark exceeds background soil concentrations, it is generally safe to assume that the benchmark is a poor measure of risk at that site.

References:

Will, M.E. and G.W. Suter II. 1994. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-85/R1.

4.4 SEDIMENT-ASSOCIATED ORGANISMS (see Hull and Suter, 1994)

This data file contains benchmarks for screening contaminants at waste sites for effects on sediment-associated organisms. Currently, there are a limited number of federal, state, and foreign sediment quality criteria, standards or guidelines that are available for use in ecological risk assessments. The derivation of these values is discussed in Hull and Suter (1994). Potential screening benchmarks for sediments were selected from the following sources:

1. EPA Sediment Quality Criteria (SQC).

2. National Oceanic and Atmospheric Administration (NOAA) values for sediment quality. Although these are not criteria or standards, EPA Region IV has issued a memorandum quoting these values as suggested guidance for evaluating sediment contamination data.

3. The State of Washington Sediment Quality Values.

4. Ontario Ministry of the Environment Sediment Quality Guidelines

5. EPA Region V Sediment Classification System

The various endpoints used in setting criteria, standards or guidelines are listed below:

Apparent Effects Threshold (AET). A concentration of a contaminant in sediments above which statistically significant biological effects always occur.

Effects Range-Low (ER-L). The lower 10th percentile of the ranked chemical concentrations observed or predicted to be associated with biological effects, based on either the Equilibrium-Partitioning approach (EqP), spiked sediment toxicity test approach, or a synoptic evaluation of biological and chemical data gathered in field surveys. Developed by NOAA.

Effects Range-Median (ER-M). The median percentile of the ranked chemical concentrations observed or predicted to be associated with biological effects, based on either the Equilibrium-Partitioning approach (EqP), spiked sediment toxicity test approach, or a synoptic evaluation of biological and chemical data gathered in field surveys. Developed by NOAA.

Sediment Quality Criterion (SQC). Sediment quality criteria have been developed by EPA for five nonionic organics (acenaphthene, dieldrin, endrin, fluoranthene, and phenanthrene) using the Equilibrium-Partitioning (EqP) approach (EPA, 1993a-e). The SQC are dependant on the organic carbon (OC) content of the sediment. In this data file, SQCs are presented for 1% OC.

Estimated Equivalent Sediment Quality Criterion. Sediment values equivalent to SQC were estimated by ORNL using the Equilibrium-Partitioning (EqP) approach, and calculated for 1% OC. To calculate a SQC, water quality benchmarks, such as National Ambient Water Quality Criteria, and the log octanol-water partition coefficient for the chemical are needed.

Sediment Quality Value. A SQC for ionic/polar organics derived by the state of Washington from an apparent effects threshold (AET) which was identified using the sediment triad approach.

Lowest Effect Level. A sediment quality guideline developed by the Ontario Ministry of the Environment (MOE) using the screening level concentration (SLC) approach. This level of sediment contamination is one that can be tolerated by most benthic organisms.

Sediment Classification Guideline. A sediment quality guideline developed by EPA Region V for use in harbors of the Great Lakes. The guideline used in this database identifies sediments that are nonpolluted.

References:

EPA (U.S. Environmental Protection Agency). 1993a. *Sediment Quality Criteria for the Protection of Benthic Organisms - Acenaphthene.* EPA-822-R-93-013. Washington, DC.

EPA (U.S. Environmental Protection Agency). 1993b. *Sediment Quality Criteria for the Protection of Benthic Organisms - Dieldrin.* EPA-822-R-93-015. Washington, DC.

EPA (U.S. Environmental Protection Agency). 1993c. *Sediment Quality Criteria for the Protection of Benthic Organisms - Endrin.* EPA-822-R-93-016. Washington, DC.

EPA (U.S. Environmental Protection Agency). 1993d. *Sediment Quality Criteria for the Protection of Benthic Organisms - Fluoranthene.* EPA-822-R-93-012. Washington, DC.

EPA (U.S. Environmental Protection Agency). 1993e. *Sediment Quality Criteria for the Protection of Benthic Organisms - Phenanthrene.* EPA-822-R-93-014. Washington, DC.

Hull, R.N. and G.W. Suter II. 1994. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1994 Revision. Oak Ridge National Laboratory, Oak Ridge TN. ES/ER/TM-95/R1.

ES/ER/TM-86/R1

Toxicological Benchmarks for Wildlife: 1994 Revision

D. M. Opresko[1]
B. E. Sample[2]
G. W. Suter[2]

Date Issued—September 1994

Prepared by
Health Sciences Research Division[1]
and Environmental Sciences Division[2]
Oak Ridge National Laboratory
under direction from the
Environmental Risk Assessment Council

Prepared for
United States Department of Energy
Office of Environmental Restoration and Waste Management
under budget and reporting code EW 20

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6285
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

ES/ER/TM-85/R1

Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1994 Revision

M. E. Will
G. W. Suter II

Date Issued—September 1994

Prepared by
Environmental Sciences Division
Oak Ridge National Laboratory
under direction from the
Environmental Restoration Risk Assessment Council

Prepared for
U.S. Department of Energy
Office of Environmental Restoration and Waste Management
under budget and reporting code EW 20

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6285
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

ES/ER/TM-96/R1

Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1994 Revision

G. W. Suter II[1]
J. B. Mabrey[2]

Date Issued—July 1994

[1]Environmental Sciences Division
Oak Ridge National Laboratory
Oak Ridge, Tennessee

[2]University of West Florida
Pensacola, Florida

Prepared by
Environmental Sciences Division
Oak Ridge National Laboratory
under direction from the
Environmental Restoration Risk Assessment Council

Prepared for
U.S. Department of Energy
Office of Environmental Restoration and Waste Management
under budget and reporting code EW 20

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6285
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

ES/ER/TM-95/R1

Energy Systems Environmental Restoration Program
ORNL Environmental Restoration Program

Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1994 Revision

R. N. Hull[1]
G. W. Suter II

Date Issued—June 1994

Prepared by
Environmental Sciences Division
Oak Ridge National Laboratory
and
Jaycor Environmental[1]
Vienna, Virginia

Prepared for
U.S. Department of Energy
Office of Environmental Restoration and Waste Management
under budget and reporting code EW 20

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6285
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

APPENDIX F

SECTION 6.0 SUPPORT MATERIAL

- **F-1 OB Source Scenario Data**
- **F-2 OD Source Scenario Data**
- **F-3 Comparison of SCREEN Versus TSCREEN Modeling Results**
- **F-4 Comparison of Other Dispersion Models for OB/OD Sources**
- **F-5 Development and Use of Critical Source Release Parameters for Air Dispersion Modeling of Open Burning and Open Detonation Treatment Units**

APPENDIX F-1

OB SOURCE SCENARIO DATA

APPENDIX F-1

OB SOURCE SCENARIO DATA

Table F-1 provides a summary of default OB source scenario values. Discussions of the basis for these values follow. Supporting POLU and SCREEN modeling output is provided in Attachments F-1-A through C.

F-1.1 BURN PAN DIMENSIONS

A typical burn pan used by the Army for OB treatment is as follows:

- Length = 16 ft (4.88 m)
- Width = 4 ft (1.22 m)
- Height = 1 ft (0.30 m)

These dimensions correspond to the OB pan design tested by the Army Ammunition Equipment Directorate of Tooele Army Depot (U.S. Army, March 1986).

Table F-1. Default OB source scenario values

Parameters	Default value
Source release height (m)	0.5
Source diameter (m)	2.8
Exit velocity (m/s)	
• Propellants	1.0[a] - 6.0[b]
• Other energetic material items	0.1[a] - 3.0[b]
• Dunnage	0.2[a] - 3.0[b]
Exit temperature (K)	
• Propellants	1,000
• Other energetic material items	1,000
• Dunnage	700
Receptor height (m)	0.0
Release duration (s)	
• Propellants	10[c]
• Dunnage	3,600

[a]Based on Tooele data.
[b]Typical OB exit velocities of 6 m/s for propellants and 3 m/s for explosives and energetic materials requiring auxiliary fuels to sustain treatment have been reported based on additional field studies (see Appendix F-5). Use of lower exit velocities is conservative (i.e., it results in higher maximum ground-level concentrations).
[c]Can be simulated as 1-min release, since exposure parameters of less than 1 min are not being evaluated.

The horizontal area of the burn pan is 64 ft^2 (6.0 m^2). Thus, a typical OB pan can be modeled as a stack with a corresponding equivalent diameter of 9 ft (2.7 m). This 2.7 m diameter value is considered as a reasonable default value for OB modeling if installation-specific information is not available.

F-1.2 OB BURN RATES DURATION

The OB test conducted at Tooele provided information on expected burn rate and duration values (see Table F-1.2-1). Burn durations are a function of the depth of material in the pan as well as the type of material treated and use of dunnage. For example, the burn duration of a 3 in. layer of M-26 propellant was about 10 sec and approximately 37 mins for flaked TNT. Burn rates are a function of the type of material treated and use of dunnage. However, observations during the Tooele tests indicate that the burn time for the energetic material was not substantially different if it was wet or if dunnage was used (but the dunnage itself took over an hour to burn).

Table F-1.2-1. OB burn duration and rates on Tooele data

Test no.	Propellant type	Propellant dry weight (μ)	Depth of propellant (in.)	Burn duration (s)	Burn rate (m/sec)
1	M-26 (dry)	610	3	9	0.3
2	M-26 (dry)	610	3	12	0.3
3	Flaked TNT (dry)	733	3	2,234	0.001
4	Flaked TNT (dry)	255	1	835	0.001
5	M-26 (wet, 20% water + 25 ft^3 dunnage)	155	3	3,745[a]	*a*
6	Flaked TNT (wet, 20% water + 30 ft^3 dunnage)	185	3	5,181[a]	*a*

[a]Wet propellant/TNT burn times with dunnage were observed to be similar to those for dry propellant/TNT without dunnage. Larger burn durations for Tests 5 and 6 due to dunnage burn times.

F-1.3 OB SOURCE TEMPERATURES

Initial OB flame temperature, associated with the thermal treatment of propellants, can exceed 3,500 K (5,840°F) for some materials.

The POLU model was developed by the U.S. Navy to simulate OB and OD source conditions. The model assumes that combustion gases will expand as the pressure drops from 1,000 to 14.7 psi. (Baroody and Tominack, January 1987; Baroody, April 1994).

The plume temperature at standard pressure (14.7 psi) can be used as dispersion modeling input to determine cloud/plume rise. POLU provides flame temperature values for various energetic material to air ratios. Table F-1.3-1 provides the maximum, average and minimum for nitrocellulose, nitroglycerin and nitroguanidine (primary components of most propellants).

A OB source temperature of 1,000 K is considered as a default value for OB treatment of energetic materials. A value of 700 K is appropriate if dunnage is used.

For comparison purposes a typical source temperature of 2,173 K is associated with the combustion of hydrocarbons in furnaces and 1,473 K for industrial flares. (Leakey et al., March 1993). Forest fire measurements indicate temperature at a 1-ft height above the ground ranging from a low of 339 K (for backfires) to 1,144 K (for headfires). (USDA, June 1960).

Table F-1.3-1. Summary of POLU results for OB flame temperatures (K at 14 psi)

	Primary propellant components			Propellant statistics			
Parameter	Nitro-cellulose	Nitro-glycerin	Nitro-guanidine	Maximum	Average	Minimum	Dunnage (cellulose)
Maximum	1,315	2,224	1,034	2,224	1,524	1,034	795
Average	1,063	1,265	814	1,265	1,047[a]	814	704[b]
Minimum	388	290	319	388	332	290	612

[a]Default value of 1,000 K recommended for OB modeling of treatment of energetics.
[b]Default value of 700 K recommended for OB modeling of dunnage.

Measured OB flame temperature available from OB test at Tooele provide a basis for comparison with the POLU calculated values. These data are summarized in Table F-1.3-2. There is reasonable agreement between the POLU and test measurement flame temperature. However, the average POLU temperature will tend to underestimate actual temperatures by over 100 K. Thus, use of the POLU values is a conservative approach which will underestimate cloud/plume height.

Table F-1.3-2. Comparison of POLU and Tooele test measurement of OB flame temperature

Test no.	Propellant type	Propellant dry weight (μ)	Measured temperature (K)	POLU calculated temperature (K)		
				Maximum	Average	Minimum
1	M-26 (dry)	610	927	1,290	1,057	406
2	M-26 (dry)	610	1,073	1,290	1,057	406
3	Flaked TNT (dry)	733	>1,360	1,108	982	563
4	Flaked TNT (dry)	255	1,224	1,108	982	563
5	M-26 (wet, 20% water + 25 ft^3 dunnage)[a]	155	634	856	747	558
6	Flaked TNT (wet, 20% water + 30 ft^3 dunnage)[a]	185	1,169	840	751	583
Average			1,065	1,082	929	513

[a]Cellulose was used as the best available constituent from the POLU chemical library to model dunnage.

F-1.4 OB EXIT VELOCITY

OB exit velocities were not measured during the Tooele tests. However, data on burn durations and pan burn areas can be used with estimates of total gas release (provided by POLU modeling) to calculate exit velocities as follows:

$$v_{OB} = \frac{V \times Q}{A \times t} \qquad \text{Eq. F-1.4-1}$$

where

v_{OB} = Exit velocity (m/s)

V = Total volume of gases produced by burn from POLU per kg energetic material treated (m^3/kg)

A = Burn area (m^2)

Q = Quantity of energetic material treated (kg)

t = Burn duration (s)

Calculated exit velocities for Tooele OB test scenarios are presented in Table F-1.4-1. Exit velocities of about 10 m/s were estimated for the M-26 propellant burns, 0.1 m/s for TNT burns and 0.2 m/s for dunnage burns. These values represent reasonable default values for OB modeling. However, it should be noted that observations of plume rise near the burn source were estimated (based on evaluation of videotapes taken at Indian Head and Crane) to be approximately 6 m/s for propellants and 3/ms for explosives and energetics requiring fuels to sustain treatment (see Appendix F-5). Use of lower exit velocities is conservative (i.e., it results in higher maximum ground-level concentrations). Site-specific estimates of OB exit velocities based on field observation or measurements should be used as available.

Table F-1.4-1. Calculated OB exit velocities based on Tooele test scenarios and POLU estimates of total gas value

Tooele test no.	Propellant type	Propellant dry weight (μ)	POLU total volume of gases at 14.7 psi (m^3/kg)	Pan burn area (m^2)	Measured burn duration (sec)	Calculated exit velocity (m/sec)
1	M-26 (dry)	277	2.3	6.0	9	11.8
2	M-26 (dry)	277	2.3	6.0	12	8.8
3	Flaked TNT (dry)	333	2.4	6.0	2,234	0.06
4	Flaked TNT (dry)	116	2.4	6.0	835	0.06
5	M-26 (wet, 20% water + 25 ft^3 dunnage)	70	2.6	1.5	3,745[a]	0.2
6	Flaked TNT (wet, 20% water + 30 ft^3 dunnage)	84	2.6	1.5	5,181[a]	0.2

[a]Wet propellant/TNT burn times with dunnage were observed to be similar to those for dry propellant/TNT without dunnage. Longer burn durations for Tests 5 and 6 were due to dunnage burn time.

F-1.5 TOTAL HEAT RELEASED

Version 13L of POLU provides calculated values for the total heat released in terms of calories per gram of energetic material burned. A heat release rate (cal/s) is needed to run the "flare" options of SCREEN. The "nonflare" options of SCREEN use input standard ambient temperatures to compute plume rise in lieu of using an input heat release rate. The heat release rate can be calculated using the heat release value from POLU for input to SCREEN (flare) as follows (Schulze, January 1981).

$$Q_R = \frac{V_{C_b} \, \delta \, (T_s - T_a)}{t} \qquad \text{Eq. F-1.5-1}$$

where

Q_R = Heat release rate (cal/sec)

V = Total volume of gases produced by burn based on POLU

C_b = Specific heat of air (0.24 cal/g K)

δ = Density of air (1,205 g/m^3)

T_s = Release temperature (K)

T = Ambient temperature (293 K)

t = Burn duration (s)

The heat release rate can also be calculated based on the total heat quantity value provided by POLU as follows:

$$Q_R = \frac{Q_T}{t} \qquad \text{Eq. F-1.5-2}$$

and

$$Q_T = Q \times Q_r \qquad \text{Eq. F-1.5-3}$$

where

Q_T = Total heat released (cal)

Q = Quantity of energetic material treated (g)

Q_r = Heat release per weight of material treated (cal/g)

A comparison of Q_R values based on the alternative approaches is provided in Table F-1.5-1 for an example propellant (M-26). The calculated heat release rate based on Eq. F-1.5-2 is about five times higher than that based on Eq. F-1.5-1.

Table F-1.5-1. Comparison of alternative approaches for calculation of heat release rates for propellant M-26

Parameters	Eq. F-1.5-1	Eq. F-1.5-2
V_1 total value of gases (m^3)[a]	637	--
T_s, release temperature (K)[a]	1,057	--
t, burn duration (s)[b]	10.5	10.5
Q, quantity of energetic material[b]	277	277
Q_r, heat release (cal/g)[a]	--	2,513
Q_r, heat release rate (cal/s)	1.3 E7	6.6 E7

[a]Based on POLU result for M-26.
[b]Based on Tooele OB Tests 1 and 2.

Table F-1.5-2. Comparison of SCREEN modeling results for alternative heat release methodologies

		Flare	
Parameters	Nonflare	Heat release calculated (Eq. F-1.5-1)	Heat release based on POLU (Eq. F-1.5-2)
Emission rate (g/s)	1.0	1.0	1.0
Stack height (m)	0.5	0.5	0.5
Stack inside diameter (m)	2.76	2.76	2.76
Stack exit velocity (m/s)[a]	10.3	10.3	10.3
Stack exit temperature (K)[b]	1,057	1,057	--
Ambient air temperature (k)	293	293	293
Receptor height (m)	0.0	0.0	0.0
Heat release rate	--	1.3 E7	6.6 E7
Maximum concentration (seg/m^3)[c]	4.3	1.7	0.4
Distance to minimum concentration (m)[c]	691	1,021	1,302
Plume height at maximum concentration (m)[c]	37.4	56.8	830.4

[a]Based on propellant M-20.
[b]Based on POLU data for propellant M-26.
[c]Based on full meteorology.

A comparison of SCREEN results is presented in Table F-1.5-2 for nonflare versus flare options based on a burn scenario for propellant M-26. The nonflare SCREEN results are the most conservative (i.e., highest concentration and lowest plume height). Table F-1.5-2 also presents a comparison of SCREEN (flare) results for the alternative approaches for calculating the heat release rate. Modeling results indicate that the heat release rate approach based on Eq. F-1.5-1 is very conservative (i.e., highest concentration and lowest plume height) compared to Eq. F-1.5-2.

The INPUFF model does not have a flare option. However, considering the SCREEN results (flare versus nonflare), the INPUFF results can be considered conservative (i.e., higher concentrations and lower cloud heights) compared to modeling a flare scenario.

F-1.6 OB SOURCE TERM SENSITIVITY ANALYSIS

A sensitivity analysis was conducted using the SCREEN model (nonflare) for a range of source conditions. These results are summarized in Table F-1.6-1 based on the "full meteorology" data set of SCREEN. This meteorological set indicates some conditions (stable as well as high wind speeds) during which OB operations are not conducted based on Army policy.

Following are the key conclusions from the sensitivity analysis:

- Release height: As would be expected, modeling results were not affected by the 0-0.5 m release height range (typical conditions) evaluated.
- Source (stack) diameter: Variations in diameter from 1-10 m result in significant changes in maximum concentration and cloud height.
- Exit velocity: Maximum concentrations and cloud height are very sensitive to exit velocity.
- Source temperature: Significant factor for maximum concentration and cloud height for 300-2,000 K range of temperatures evaluated.
- Receptor height: Not a significant factor for receptors evaluated.

Table F-1.6-1. SCREEN (nonflare) sensitivity analysis - OB

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Emission rate (g/s)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Stack height	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Stack inside diameter (m)	3	3	1	3	10	3	3	3	3	3	3	3	3	3	3	3	3	3
Stack exit velocity (m/s)	10.0	10.0	10.0	10.0	10.0	0.01	0.1	1.0	3.0	10.0	20.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Stack exit temperature (K)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	300	700	1,000	1,500	2,000	1,000	1,000
Ambient air temperature	293	293	293	293	293	293	293	293	293	293	293	293	293	293	293	293	293	293
Receptor height (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
Maximum 1-hr concentration ($\mu g/m^3$)[a]	3.735	3.735	80.5	3.735	0.3044	4,321	741.8	94.67	17.46	3.735	1.535	259.4	4.767	3.735	3.179	2.954	3.735	3.741
Decline to maximum concentration (m)[a]	749	749	137	749	1,419	100	100	125	313	749	1,162	100	653	749	820	855	749	747
Plume height at maximum concentration (m)[b]	40.1	40.1	9.1	40.1	1132.4	5.3	3.7	8.4	19.2	40.1	60.7	4.5	35.6	40.1	43.3	44.8	40.1	40.1

[a]Full meterology.
[b]Typical conditions (used for modeling scenarios unless indicated otherwise).

ATTACHMENT F-1-A

POLU MODELING RUNS (OB)

MATERIAL=NITROCELLULOSE 100%

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---

H C N O

NITROCELLULOSE(12.6) 0.0080.0060.0020.0100.0000.0000.0000.0000.0000.0000.0000.000 100.000 -625. 0.0600
AIR -(G 0.0000.0000.0060.0010.0000.0000.0000.0000.0000.0000.0000.000 0.000 0. 0.0000
0GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000
0 (H) (C) (N) (O) (
2.771700 2.202676 0.899426 3.634415

WT. MATERIAL	100.000	90.000	80.000	70.000	60.000	50.000	40.000	30.000	20.000	10.000
WT.--LAST INGREDIENT	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000
OXID/MATERIAL RATIO	0.0000	0.1111	0.2500	0.4286	0.6667	1.0000	1.5000	2.3333	4.0000	9.0000

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---
--CAUTION: DATA BELOW FLAME TEMP. OF 300 K QUESTIONABLE.

FLAME TEMP. T(K)	2510.419	2558.925	2610.028	2663.338	2716.764	2760.101	2730.106	2408.471	1830.328	1136.464
FLAME TEMP. T(F)	4059.355	4146.665	4238.650	4334.608	4430.776	4508.782	4454.792	3875.848	2835.191	1586.236
ENTHALPY KCAL/GFW	-62.484	-56.236	-49.987	-43.739	-37.490	-31.242	-24.994	-18.745	-12.497	-6.248

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.7000 PSI---

FLAME TEMP. T(K)	1124.243	1149.068	1175.725	1204.453	1235.715	1270.597	1315.468	1052.365	715.827	388.271
FLAME TEMP. T(F)	1564.237	1608.922	1656.905	1708.616	1764.886	1827.674	1908.443	1434.856	829.088	239.488
ENTHALPY KCAL/GFW	-121.025	-114.236	-107.456	-100.688	-93.937	-87.200	-80.324	-65.109	-46.528	-26.517
T.VOL.GASES--LITERS	90.610	97.631	106.404	117.682	132.721	153.773	185.349	248.389	378.371	768.310
(GASES AT STP)										
TOTAL HEAT RELEASED*	929.795	1029.627	1154.440	1314.890	1528.747	1827.993	2276.552	2394.219	2394.111	2393.615

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-03

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

CO2	37.821	41.062	45.277	50.946	58.993	71.176	91.287	96.932	96.927	96.912
CO	37.622	35.561	32.880	29.271	24.150	16.395	3.595	0.000	0.000	0.000
N2	12.598	21.359	32.311	46.391	65.165	91.448	130.873	196.577	327.997	722.244
H2O	10.315	11.632	13.214	15.146	17.522	20.473	24.148	24.964	24.963	24.958
H2	1.639	1.492	1.315	1.099	0.833	0.503	0.091	0.000	0.000	0.000
CH4	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N2O5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	14.844	50.101	155.860
NO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.000	0.000

*THE TOTAL HEAT RELEASED, IN CAL/GR AT STP, IN EACH COLUMN IS FOR 100 GRAMS
OF MATERIAL BURNED OR DETONATED, NOT THE MATERIAL WT. LISTED IN "WT. MATERIAL" ROW.
USE THESE VALUES IN DISPERSION MODELS.

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

CO2	CO	N2	H2O	H2	CH4	NH3	N2O5	N2O4	N2O4$	N2O4*	C4N2	N2O3	C3O2	NHO3
NO3	C5	C4H10	C4H8	C2N2	C4	O3	NHO2	NO2	C3H8	C2H4O	N2O	CNHO	C3H6	N3
CNO	CN2	CN2	C2O	C2N	C3	H2O2	HO2	N2H4	N2H4*	O2	NHO	C2H6	N2H2	CH2O
NO	NO	CHO	CHO	C2H4	CNH	C2H2	CN	CN	C2H	C2	H3O	H2O*	H2O*	HO
HO	NH2	O	CH3	NH	CH2	N	CH	C	C$	C$	H	H		

MATERIAL=NITROGLYCERIN 100%

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---

```
                                   H    C    N    O

 NITROGLYCERIN - NG        0.0050.0030.0030.0090.0000.0000.0000.0000.0000.0000.0000.000  100.000     -392.   0.0578
 AIR          -(G          0.0000.0000.0060.0010.0000.0000.0000.0000.0000.0000.0000.000    0.000        0.   0.0000
0GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF  100.000                                                    1.0000
0   (H )     (C )     (N )     (O )      (
  2.201702  1.321021  1.321021  3.963064
```

WT. MATERIAL	100.000	90.000	80.000	70.000	60.000	50.000	40.000	30.000	20.000	10.000
WT.--LAST INGREDIENT	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000
OXID/MATERIAL RATIO	0.0000	0.1111	0.2500	0.4286	0.6667	1.0000	1.5000	2.3333	4.0000	9.0000

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---
--CAUTION: DATA BELOW FLAME TEMP. OF 300 K QUESTIONABLE.

FLAME TEMP. T(K)	3293.035	3209.527	3106.453	2972.734	2789.868	2535.237	2203.519	1812.268	1370.251	871.028
FLAME TEMP. T(F)	5468.063	5317.749	5132.215	4891.521	4562.362	4104.026	3506.935	2802.683	2007.052	1108.450
ENTHALPY KCAL/GFW	-39.234	-35.311	-31.387	-27.464	-23.540	-19.617	-15.694	-11.770	-7.847	-3.923

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.7000 PSI---

FLAME TEMP. T(K)	2224.246	2052.723	1834.060	1602.204	1373.287	1148.894	927.111	707.174	490.708	289.707
FLAME TEMP. T(F)	3544.242	3235.501	2841.907	2424.568	2012.516	1608.609	1209.400	813.513	423.874	62.072
ENTHALPY KCAL/GFW	-115.980	-108.370	-99.975	-90.674	-80.494	-69.532	-57.891	-45.630	-32.739	-19.201
T.VOL.GASES--LITERS (GASES AT STP)	72.384	80.534	91.181	105.069	123.631	149.628	188.621	253.609	383.591	773.531
TOTAL HEAT RELEASED*	1556.679	1586.445	1598.162	1601.362	1602.317	1602.646	1602.707	1602.642	1602.478	1601.983

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-03

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

CO2	56.144	57.623	58.071	58.131	58.134	58.133	58.132	58.129	58.124	58.109
H2O	19.505	19.691	19.789	19.822	19.830	19.831	19.831	19.830	19.828	19.824
N2	18.365	27.130	38.112	52.235	71.043	97.346	136.777	202.487	333.903	728.150
O2	4.016	5.838	8.687	12.513	17.593	24.667	35.251	52.879	88.132	193.892
CO	1.268	0.326	0.041	0.003	0.000	0.000	0.000	0.000	0.000	0.000
HO	0.354	0.192	0.070	0.017	0.002	0.000	0.000	0.000	0.000	0.000
NO	0.298	0.290	0.223	0.132	0.059	0.017	0.003	0.000	0.000	0.000
O	0.032	0.013	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H2	0.015	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N2O5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001

*THE TOTAL HEAT RELEASED, IN CAL/GR AT STP, IN EACH COLUMN IS FOR 100 GRAMS
OF MATERIAL BURNED OR DETONATED, NOT THE MATERIAL WT. LISTED IN "WT. MATERIAL" ROW.
USE THESE VALUES IN DISPERSION MODELS.

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

CO2	H2O	N2	O2	CO	HO	NO	O	H2	H	HO2	N2O5	N2O4	N2O4$	N2O4*
C4N2	N2O3	C3O2	NHO3	NO3	C5	C4H10	C4H8	C2N2	C4	O3	NHO2	NO2	C3H8	C2H4O
N2O	CNHO	C3H6	N3	CNO	CN2	CN2	C2O	C2N	C3	H2O2	N2H4	N2H4*	NHO	C2H6
N2H2	CH2O	NO	CHO	CHO	C2H4	CNH	C2H2	CN	CN	C2H	C2	H3O	H2O*	H2O*
NH3	HO	CH4	NH2	CH3	NH	CH2	N	CH	C	C$	C$	H		

MATERIAL=NITROGUANIDINE 100%

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---

	H C N O			
NITROGUANIDINE	0.0040.0010.0040.0020.0000.0000.0000.0000.0000.0000.0000.000	100.000	-209.	0.0625
AIR -(6	0.0000.0000.0060.0010.0000.0000.0000.0000.0000.0000.0000.000	0.000	0.	0.0000

OGRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

0 (H)	(C)	(N)	(O)	(
3.843382	0.960846	3.843382	1.921691	

WT. MATERIAL	100.000	90.000	80.000	70.000	60.000	50.000	40.000	30.000	20.000	10.000
WT.--LAST INGREDIENT	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000
OXID/MATERIAL RATIO	0.0000	0.1111	0.2500	0.4286	0.6667	1.0000	1.5000	2.3333	4.0000	9.0000

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

--CAUTION: DATA BELOW FLAME TEMP. OF 300 K QUESTIONABLE.

FLAME TEMP. T(K)	1850.352	1939.745	2035.321	2138.042	2249.347	2370.640	2421.879	2025.204	1541.787	976.048
FLAME TEMP. T(F)	2871.233	3032.141	3204.177	3389.075	3589.425	3807.752	3899.982	3185.968	2315.817	1297.487
ENTHALPY KCAL/GFW	-20.900	-18.810	-16.720	-14.630	-12.540	-10.450	-8.360	-6.270	-4.180	-2.090

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.7000 PSI---

FLAME TEMP. T(K)	866.930	868.460	873.885	891.641	934.166	990.612	1033.910	799.183	559.673	319.499
FLAME TEMP. T(F)	1101.075	1103.828	1113.594	1145.553	1222.100	1323.702	1401.638	979.129	548.011	115.698
ENTHALPY KCAL/GFW	-70.502	-68.483	-66.585	-64.799	-63.081	-61.396	-58.898	-46.509	-33.438	-19.621
T.VOL.GASES--LITERS (GASES AT STP)	102.967	111.478	121.813	134.406	149.878	170.960	203.227	268.220	398.197	788.137
TOTAL HEAT RELEASED*	762.618	842.812	947.123	1090.643	1299.648	1599.876	2008.641	2008.570	2008.405	2007.910

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-03

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

N2	53.829	62.590	73.543	87.625	106.401	132.686	172.111	237.820	369.236	763.484
CO2	21.889	23.784	26.014	28.465	31.136	35.271	42.280	42.278	42.273	42.257
H2O	10.288	11.559	13.326	16.049	20.453	26.687	34.619	34.618	34.617	34.612
CO	9.969	9.695	9.251	8.508	7.076	4.462	0.000	0.000	0.000	0.000
H2	2.287	2.279	2.222	2.036	1.582	0.887	0.000	0.000	0.000	0.000
CH4	1.725	1.191	0.632	0.164	0.010	0.000	0.000	0.000	0.000	0.000
NH3	0.010	0.010	0.009	0.007	0.003	0.001	0.000	0.000	0.000	0.000
N2O5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
O2	0.000	0.000	0.000	0.000	0.000	0.000	0.982	18.609	53.863	159.622
NO	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000

*THE TOTAL HEAT RELEASED, IN CAL/GR AT STP, IN EACH COLUMN IS FOR 100 GRAMS OF MATERIAL BURNED OR DETONATED, NOT THE MATERIAL WT. LISTED IN "WT. MATERIAL" ROW. USE THESE VALUES IN DISPERSION MODELS.

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

N2	CO2	H2O	CO	H2	CH4	NH3	N2O5	N2O4	N2O4$	N2O4*	C4N2	N2O3	C3O2	NHO3
NO3	C5	C4H10	C4H8	C2N2	C4	O3	NHO2	NO2	C3H8	C2H4O	N2O	CNHO	C3H6	N3
CNO	CN2	CN2	C2O	C2N	C3	H2O2	HO2	N2H4	N2H4*	O2	NHO	C2H6	N2H2	CH2O
NO	NO	CHO	CHO	C2H4	CNH	C2H2	CN	CN	C2H	C2	H3O	H2O*	H2O*	HO
HO	NH2	O	CH3	NH	CH2	N	CH	C	C$	C$	H	H		

MATERIAL=CELLULOUS-100%

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---

H C N O

CELLULOSE	0.0100.0060.0000.0050.0000.0000.0000.0000.0000.0000.0000.000	100.000	-1417.	0.0458
AIR -(G	0.0000.0000.0060.0010.0000.0000.0000.0000.0000.0000.0000.000	0.000	0.	0.0000

OGRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

0 (H) (C) (N) (O) (

6.167281 3.700369 0.000000 3.083641

WT. MATERIAL	100.000	90.000	80.000	70.000	60.000	50.000	40.000	30.000	20.000	10.000
WT.--LAST INGREDIENT	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000
OXID/MATERIAL RATIO	0.0000	0.1111	0.2500	0.4286	0.6667	1.0000	1.5000	2.3333	4.0000	9.0000

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

--CAUTION: DATA BELOW FLAME TEMP. OF 300 K QUESTIONABLE.

FLAME TEMP. T(K)	942.117	978.320	1012.850	1046.304	1079.600	1113.942	1151.162	1323.679	1869.896	1624.240
FLAME TEMP. T(F)	1236.410	1301.576	1363.730	1423.948	1483.880	1545.696	1612.692	1923.222	2906.413	2464.233
ENTHALPY KCAL/GFW	-141.700	-127.530	-113.360	-99.190	-85.020	-70.850	-56.680	-42.510	-28.340	-14.170

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.7000 PSI---

FLAME TEMP. T(K)	611.529	638.456	664.629	690.402	716.223	742.538	769.751	794.711	798.479	611.940
FLAME TEMP. T(F)	641.352	689.820	736.932	783.323	829.801	877.169	926.152	971.080	977.863	642.093
ENTHALPY KCAL/GFW	-162.800	-150.081	-137.387	-124.718	-112.072	-99.451	-86.862	-74.684	-66.061	-44.465
T.VOL.GASES--LITERS	124.891	133.075	143.506	156.954	174.646	198.826	233.894	290.040	401.511	771.089
(GASES AT STP)										
TOTAL HEAT RELEASED*	505.209	563.392	635.911	728.493	851.533	1022.717	1279.076	1716.070	2775.955	4171.163

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-03

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

H2O	30.668	30.205	29.723	29.150	28.433	27.444	26.085	24.530	29.998	55.546
CO2	30.339	34.058	38.527	44.103	51.278	60.919	74.516	95.468	135.542	162.827
C$	28.816	28.074	27.212	26.097	24.508	22.026	17.827	10.218	0.000	0.000
CH4	9.773	9.352	8.757	7.982	7.031	5.912	4.664	3.408	1.188	0.000
H2	0.328	0.485	0.688	0.946	1.265	1.657	2.122	2.612	2.558	0.000
CO	0.074	0.173	0.375	0.781	1.579	3.186	6.503	13.104	15.301	0.000
O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	71.957
N2	0.000	8.755	19.703	33.781	52.553	78.835	118.259	183.968	315.386	709.646
N2O5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
NH3	0.000	0.007	0.010	0.013	0.015	0.017	0.017	0.017	0.014	0.000

*THE TOTAL HEAT RELEASED, IN CAL/GR AT STP, IN EACH COLUMN IS FOR 100 GRAMS
OF MATERIAL BURNED OR DETONATED, NOT THE MATERIAL WT. LISTED IN "WT. MATERIAL" ROW.
USE THESE VALUES IN DISPERSION MODELS.

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

H2O	CO2	C$	CH4	H2	CO	C3O2	C5	C2H6	C4H10	C4H8	C4	O3	C3H8	C2H4O
C3H6	C2O	C3	H2O2	HO2	O2	CH2O	CHO	CHO	C2H4	C2H2	C2H	C2	H3O	H2O*
H2O*	HO	HO	O	CH3	CH2	CH	C	C$	N2O4$	CNHO	N2	CN2	N2H4*	CN2
C2N	CNH	NO	N2H2	CNO	NO	CN	NHO3	CN	H	H	N2O	NH	NHO2	N2O5
NHO	N	N2O4	C4N2	C2N2	NO3	N2O3	N3	NH2	NH3	NO2	N2H4	N2O4*		

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---

	H C N O K BA			
NITROCELLULOSE(12.6)	0.0080.0060.0020.0100.0000.0000.0000.0000.0000.0000.0000.000	67.250	-625.	0.0600
NITROGLYCERIN - NG	0.0050.0030.0030.0090.0000.0000.0000.0000.0000.0000.0000.000	25.000	-392.	0.0578
ETHYL CENTRALITE-EC	0.0200.0170.0020.0010.0000.0000.0000.0000.0000.0000.0000.000	6.000	-117.	0.0451
BARIUM NITRATE	0.0000.0000.0020.0060.0000.0010.0000.0000.0000.0000.0000.000	0.750	-912.	0.1171
POTASSIUM NITRATE	0.0000.0000.0010.0030.0010.0000.0000.0000.0000.0000.0000.000	0.700	-1165.	0.0762
CARBON (GRAPHITE)	0.0000.0010.0000.0000.0000.0000.0000.0000.0000.0000.0000.000	0.300	0.	0.0818
AIR -(G	0.0000.0000.0060.0010.0000.0000.0000.0000.0000.0000.0000.000	0.000	0.	0.0000

OGRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

0 (H)	(C)	(N)	(O)	(K)	(BA)	(
2.861549	2.216614	0.992497	3.495254	0.006923	0.002869	

WT. MATERIAL	100.000	90.000	80.000	70.000	60.000	50.000	40.000	30.000	20.000	10.000
WT.--LAST INGREDIENT	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000
OXID/MATERIAL RATIO	0.0000	0.1111	0.2500	0.4286	0.6667	1.0000	1.5000	2.3333	4.0000	9.0000

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

--CAUTION: DATA BELOW FLAME TEMP. OF 300 K QUESTIONABLE.

FLAME TEMP. T(K)	2473.296	2523.939	2577.575	2634.171	2692.661	2746.873	2754.928	2493.258	1903.956	1181.670
FLAME TEMP. T(F)	3992.533	4083.690	4180.236	4282.108	4387.390	4484.971	4499.471	4028.465	2967.720	1667.606
ENTHALPY KCAL/GFW	-54.027	-48.624	-43.222	-37.819	-32.416	-27.014	-21.611	-16.208	-10.805	-5.403

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.7000 PSI---

FLAME TEMP. T(K)	1097.877	1123.560	1150.882	1179.346	1209.563	1246.121	1290.333	1112.845	754.912	406.312
FLAME TEMP. T(F)	1516.779	1563.008	1612.188	1663.422	1717.813	1783.618	1863.199	1543.721	899.442	271.961
ENTHALPY KCAL/GFW	-112.802	-106.829	-100.863	-94.909	-88.977	-83.068	-77.119	-64.656	-46.405	-26.516
T.VOL.GASES--LITERS	93.026	100.062	108.847	120.151	135.225	156.284	187.854	248.389	378.342	768.303
(GASES AT STP)										
TOTAL HEAT RELEASED#	917.743	1017.217	1141.476	1300.762	1512.526	1811.482	2260.185	6329.001	6316.382	2527.933

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-03

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

CO	40.374	38.384	35.800	32.318	27.396	20.033	7.817	0.000	0.000	0.000
CO2	33.951	37.100	41.181	46.688	54.493	66.072	85.266	97.420	97.389	97.376
N2	13.901	22.663	33.614	47.694	66.468	92.752	132.176	197.879	329.300	723.547
H2O	9.022	10.375	12.011	14.011	16.491	19.690	23.737	25.763	25.772	25.767
H2	1.872	1.722	1.539	1.313	1.033	0.675	0.221	0.000	0.000	0.000
K2CO3$	0.454	0.428	0.374	0.005	0.000	0.000	0.000	0.389	0.470	0.461
Ba#	0.393	0.393	0.393	0.393	0.393	0.392	0.392	0.000	0.001	0.001
KHO	0.017	0.035	0.073	0.152	0.311	0.347	0.361	0.066	0.000	0.001
CH4	0.007	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
K	0.001	0.002	0.005	0.010	0.021	0.021	0.014	0.000	0.000	0.000
K2H2O2	0.001	0.001	0.003	0.007	0.015	0.009	0.004	0.002	0.001	0.001
BaO$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.437	0.435	0.002
K2CO3#	0.000	0.000	0.000	0.256	0.038	0.000	0.000	0.000	0.001	0.001
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Ba$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.386
Ba$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Ba$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Ba#	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
K2C2N2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
K2O2$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
N2O5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.350	46.610	152.416
NO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.000	0.000

MATERIAL=TNT 100%

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---

	H C N O			
TRINITROTOLUENE	0.0050.0070.0030.0060.0000.0000.0000.0000.0000.0000.0000.000	100.000	-78.	0.0597
AIR -(G	0.0000.0000.0060.0010.0000.0000.0000.0000.0000.0000.0000.000	0.000	0.	0.0000

0GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

0 (H) (C) (N) (O) (

2.201276 3.081786 1.320765 2.641531

WT. MATERIAL	100.000	90.000	80.000	70.000	60.000	50.000	40.000	30.000	20.000	10.000
WT.--LAST INGREDIENT	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000
OXID/MATERIAL RATIO	0.0000	0.1111	0.2500	0.4286	0.6667	1.0000	1.5000	2.3333	4.0000	9.0000

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

--CAUTION: DATA BELOW FLAME TEMP. OF 300 K QUESTIONABLE.

FLAME TEMP. T(K)	1991.383	1967.071	1941.643	2001.049	2143.014	2293.155	2453.812	2621.188	2507.082	1543.294
FLAME TEMP. T(F)	3125.090	3081.328	3035.557	3142.488	3398.026	3668.279	3957.461	4258.739	4053.348	2318.530
ENTHALPY KCAL/GFW	-7.758	-6.982	-6.206	-5.430	-4.655	-3.879	-3.103	-2.327	-1.552	-0.776

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.7000 PSI---

FLAME TEMP. T(K)	1045.037	1033.765	1022.036	1008.022	988.039	963.875	1004.563	1108.218	1084.546	562.939
FLAME TEMP. T(F)	1421.667	1401.377	1380.264	1355.039	1319.070	1275.576	1348.814	1535.392	1492.783	553.891
ENTHALPY KCAL/GFW	-57.838	-55.963	-54.074	-52.521	-52.029	-52.129	-52.665	-53.203	-49.251	-28.713
T.VOL.GASES--LITERS	108.022	115.039	123.816	135.098	150.117	171.145	203.357	256.036	368.758	758.698
(GASES AT STP)										
TOTAL HEAT RELEASED*	765.512	826.496	902.258	1004.229	1155.578	1377.585	1783.008	2530.162	3573.080	3572.668

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-03

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

CO	57.431	58.795	60.522	62.155	62.408	61.395	52.648	31.963	0.000	0.000
N2	18.499	27.260	38.211	52.291	71.065	97.348	136.774	202.483	333.893	728.147
CO2	10.860	12.819	15.280	18.882	25.079	34.824	52.860	85.402	135.617	135.602
C$	9.251	8.132	6.721	5.038	3.234	1.002	0.000	0.000	0.000	0.000
H2	1.963	1.945	1.925	1.897	1.847	1.776	1.524	0.800	0.000	0.000
H2O	1.760	1.924	2.106	2.359	2.792	3.404	6.171	12.677	19.825	19.820
CH4	0.232	0.231	0.229	0.228	0.234	0.243	0.016	0.000	0.000	0.000
NH3	0.001	0.002	0.002	0.002	0.002	0.003	0.002	0.000	0.000	0.000
N2O5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.640	116.406
NO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.000

*THE TOTAL HEAT RELEASED, IN CAL/GR AT STP, IN EACH COLUMN IS FOR 100 GRAMS
OF MATERIAL BURNED OR DETONATED, NOT THE MATERIAL WT. LISTED IN "WT. MATERIAL" ROW.
USE THESE VALUES IN DISPERSION MODELS.

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

CO	N2	CO2	C$	H2	H2O	CH4	NH3	CNH	N2O5	N2O4	N2O4$	N2O4*	C4N2	N2O3
C3O2	NHO3	NO3	C5	C4H10	C4H8	C2N2	C4	O3	NHO2	NO2	C3H8	C2H4O	N2O	CNHO
C3H6	N3	CNO	CN2	CN2	C2O	C2N	C3	H2O2	HO2	N2H4	N2H4*	O2	NHO	C2H6
N2H2	CH2O	NO	NO	CHO	CHO	C2H4	C2H2	CN	CN	C2H	C2	H3O	H2O*	H2O*
HO	HO	NH2	O	CH3	NH	CH2	N	CH	C	C$	H	H		

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---

H C N O K BA

NITROCELLULOSE(12.6)	0.0080.0060.0020.0100.0000.0000.0000.0000.0000.0000.0000.000	10.830	-625.	0.0600
NITROGLYCERIN - NG	0.0050.0030.0030.0090.0000.0000.0000.0000.0000.0000.0000.000	4.030	-392.	0.0578
ETHYL CENTRALITE-EC	0.0200.0170.0020.0010.0000.0000.0000.0000.0000.0000.0000.000	0.970	-117.	0.0451
BARIUM NITRATE	0.0000.0000.0020.0060.0000.0010.0000.0000.0000.0000.0000.000	0.120	-912.	0.1171
POTASSIUM NITRATE	0.0000.0000.0010.0030.0010.0000.0000.0000.0000.0000.0000.000	0.110	-1165.	0.0762
CARBON (GRAPHITE)	0.0000.0010.0000.0000.0000.0000.0000.0000.0000.0000.0000.000	0.050	0.	0.0818
WATER - H20	0.0020.0000.0000.0010.0000.0000.0000.0000.0000.0000.0000.000	3.200	-3792.	0.0361
CELLULOSE	0.0100.0060.0000.0050.0000.0000.0000.0000.0000.0000.0000.000	80.700	-1417.	0.0458
AIR -(G	0.0000.0000.0060.0010.0000.0000.0000.0000.0000.0000.0000.000	0.000	0.	0.0000

0GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.010 1.0000

0 (H)	(C)	(N)	(O)	(K)	(BA)	(
5.793429	3.343594	0.159880	3.229069	0.001088	0.000459	

WT. MATERIAL	100.010	90.009	80.008	70.007	60.006	50.005	40.004	30.003	20.002	10.001
WT.--LAST INGREDIENT	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000
OXID/MATERIAL RATIO	0.0000	0.1111	0.2500	0.4285	0.6666	0.9999	1.4999	2.3331	3.9996	8.9991

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

--CAUTION: DATA BELOW FLAME TEMP. OF 300 K QUESTIONABLE.

FLAME TEMP. T(K)	1034.206	1055.555	1077.399	1100.155	1124.421	1151.154	1219.120	1566.251	2053.624	1511.129
FLAME TEMP. T(F)	1402.172	1440.599	1479.918	1520.879	1564.558	1612.678	1735.015	2359.851	3237.124	2260.632
ENTHALPY KCAL/GFW	-135.185	-121.666	-108.148	-94.629	-81.111	-67.592	-54.074	-40.555	-27.037	-13.518

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.7000 PSI---

FLAME TEMP. T(K)	703.761	718.029	732.742	748.083	764.244	781.447	799.280	806.206	855.503	557.934
FLAME TEMP. T(F)	807.370	833.052	859.536	887.149	916.239	947.205	979.304	991.770	1080.505	544.882
ENTHALPY KCAL/GFW	-160.688	-148.180	-135.693	-123.228	-110.788	-98.377	-86.078	-75.303	-67.606	-41.517
T.VOL.GASES--LITERS	119.778	128.267	138.716	151.908	169.080	192.479	226.562	281.274	394.369	772.319
(GASES AT STP)										
TOTAL HEAT RELEASED*	1166.472	1221.885	1291.260	1380.326	1499.068	1665.585	1917.592	2381.671	3619.177	4308.069

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-03

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

CO2	38.122	41.454	45.516	50.597	57.141	65.892	78.290	98.822	132.175	147.088
H2O	26.401	26.065	25.663	25.156	24.501	23.653	22.595	22.414	39.068	52.173
C$	23.501	22.818	21.904	20.629	18.772	15.933	11.345	4.154	0.000	0.000
CH4	7.877	7.348	6.747	6.064	5.299	4.456	3.560	2.817	0.012	0.000
N2	2.236	10.992	21.940	36.017	54.788	81.068	120.489	186.190	317.602	711.813
H2	0.904	1.074	1.270	1.498	1.763	2.069	2.413	2.620	1.463	0.000
CO	0.807	1.202	1.798	2.731	4.233	6.753	11.129	16.125	9.480	0.000
K2CO3$	0.073	0.073	0.073	0.073	0.072	0.072	0.071	0.069	0.067	0.060
BaO$	0.069	0.069	0.069	0.069	0.069	0.069	0.068	0.067	0.066	0.061
NH3	0.004	0.008	0.011	0.013	0.014	0.015	0.015	0.015	0.004	0.000
K2CO3*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Ba$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Ba$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Ba$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Ba*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Ba*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
K2O2$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
N2O5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	88.669

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---

H C N O

TRINITROTOLUENE	0.0050.0070.0030.0060.0000.0000.0000.0000.0000.0000.0000.000	16.000	-78.	0.0597
WATER - H20	0.0020.0000.0000.0010.0000.0000.0000.0000.0000.0000.0000.000	3.200	-3792.	0.0361
CELLULOSE	0.0100.0060.0000.0050.0000.0000.0000.0000.0000.0000.0000.000	80.800	-1417.	0.0458
AIR -(G	0.0000.0000.0060.0010.0000.0000.0000.0000.0000.0000.0000.000	0.000	0.	0.0000

0GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

0 (H) (C) (N) (O) (

5.690607 3.482984 0.211322 3.091846

WT. MATERIAL	100.000	90.000	80.000	70.000	60.000	50.000	40.000	30.000	20.000	10.000
WT.--LAST INGREDIENT	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000
OXID/MATERIAL RATIO	0.0000	0.1111	0.2500	0.4286	0.6667	1.0000	1.5000	2.3333	4.0000	9.0000

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

--CAUTION: DATA BELOW FLAME TEMP. OF 300 K QUESTIONABLE.

FLAME TEMP. T(K)	1038.466	1059.691	1081.437	1104.121	1128.343	1155.074	1201.321	1517.136	2018.796	1566.319
FLAME TEMP. T(F)	1409.838	1448.043	1487.187	1528.018	1571.617	1619.734	1702.978	2271.445	3174.432	2359.973
ENTHALPY KCAL/GFW	-127.869	-115.082	-102.295	-89.508	-76.722	-63.935	-51.148	-38.361	-25.574	-12.787

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.7000 PSI---

FLAME TEMP. T(K)	709.704	723.425	737.621	752.457	768.126	784.835	802.653	812.116	840.108	583.123
FLAME TEMP. T(F)	818.067	842.764	868.318	895.022	923.228	953.302	985.375	1002.408	1052.794	590.222
ENTHALPY KCAL/GFW	-153.079	-141.330	-129.604	-117.900	-106.223	-94.574	-82.980	-72.620	-65.613	-41.849
T.VOL.GASES--LITERS (GASES AT STP)	122.671	131.188	141.660	154.858	172.026	195.407	229.471	284.259	396.788	770.878
TOTAL HEAT RELEASED*	556.173	612.609	683.286	773.985	894.905	1064.450	1319.750	1780.735	2969.915	3942.021

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-03

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

CO2	36.347	39.623	43.619	48.627	55.083	63.729	75.980	96.093	132.645	153.259
C$	25.727	25.058	24.157	22.890	21.037	18.197	13.578	6.133	0.000	0.000
H2O	25.375	25.072	24.708	24.240	23.631	22.835	21.800	21.380	33.995	51.252
CH4	7.757	7.218	6.609	5.923	5.160	4.327	3.438	2.668	0.072	0.000
N2	2.956	11.714	22.663	36.742	55.514	81.797	121.222	186.930	318.353	712.606
H2	0.946	1.115	1.308	1.533	1.792	2.090	2.430	2.670	1.912	0.000
CO	0.885	1.300	1.921	2.886	4.431	7.005	11.532	17.436	13.004	0.000
NH3	0.004	0.008	0.011	0.013	0.014	0.015	0.015	0.015	0.006	0.000
N2O5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	82.858

*THE TOTAL HEAT RELEASED, IN CAL/GR AT STP, IN EACH COLUMN IS FOR 100 GRAMS OF MATERIAL BURNED OR DETONATED, NOT THE MATERIAL WT. LISTED IN "WT. MATERIAL" ROW. USE THESE VALUES IN DISPERSION MODELS.

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

CO2	C$	H2O	CH4	N2	H2	CO	NH3	N2O5	N2O4	N2O4$	N2O4*	C2H6	C4N2	N2O3
C3O2	NHO3	NO3	C5	C4H10	C4H8	C2N2	C4	O3	NHO2	NO2	C3H8	C2H4O	N2O	CNHO
C3H6	N3	CNO	CN2	CN2	C2O	C2N	C3	H2O2	HO2	N2H4	N2H4*	O2	NHO	N2H2
CH2O	NO	NO	CHO	CHO	C2H4	CNH	C2H2	CN	CN	C2H	C2	H3O	H2O*	H2O*
HO	HO	NH2	O	CH3	NH	CH2	N	CH	C	C$	H	H		

ATTACHMENT F-1-B

OB SCREEN MODELING RUNS

(for Section F-1.5)

1

10-06-94
08:01:52

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.50
STK INSIDE DIAM (M)	=	2.76
STK EXIT VELOCITY (M/S)	=	10.30
STK GAS EXIT TEMP (K)	=	1057.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 139.03 M**4/S**3; MOM. FLUX = 56.00 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.5064	6	1.0	1.0	5000.0	128.3	36.7	36.6	NO
200.	.5227	6	1.0	1.0	5000.0	128.3	37.3	36.7	NO
300.	.9445	4	20.0	20.0	5000.0	37.4	23.2	13.2	NO
400.	2.499	4	20.0	20.0	5000.0	37.4	30.1	16.6	NO
500.	3.645	4	20.0	20.0	5000.0	37.4	36.9	19.8	NO
600.	4.188	4	20.0	20.0	5000.0	37.4	43.5	22.8	NO
700.	4.310	4	20.0	20.0	5000.0	37.4	50.1	25.8	NO
800.	4.198	4	20.0	20.0	5000.0	37.4	56.5	28.7	NO
900.	3.971	4	20.0	20.0	5000.0	37.4	62.8	31.3	NO
1000.	3.705	4	20.0	20.0	5000.0	37.4	69.0	33.8	NO
1100.	3.433	4	20.0	20.0	5000.0	37.4	75.1	35.8	NO
1200.	3.182	4	20.0	20.0	5000.0	37.4	81.1	37.6	NO
1300.	2.954	4	20.0	20.0	5000.0	37.4	87.2	39.5	NO
1400.	2.747	4	20.0	20.0	5000.0	37.4	93.2	41.3	NO
1500.	2.559	4	20.0	20.0	5000.0	37.4	99.1	43.0	NO
1600.	2.429	4	15.0	15.0	4800.0	49.8	105.5	45.7	NO
1700.	2.313	4	15.0	15.0	4800.0	49.8	111.3	47.4	NO
1800.	2.204	4	15.0	15.0	4800.0	49.8	117.2	49.0	NO
1900.	2.100	4	15.0	15.0	4800.0	49.8	123.0	50.6	NO
2000.	2.002	4	15.0	15.0	4800.0	49.8	128.7	52.1	NO
2100.	1.910	4	15.0	15.0	4800.0	49.8	134.5	53.7	NO
2200.	1.824	4	15.0	15.0	4800.0	49.8	140.2	55.2	NO
2300.	1.743	4	15.0	15.0	4800.0	49.8	145.9	56.7	NO
2400.	1.667	4	15.0	15.0	4800.0	49.8	151.6	58.2	NO
2500.	1.655	5	5.0	5.0	5000.0	90.5	119.9	45.9	NO
2600.	1.672	5	5.0	5.0	5000.0	90.5	124.1	46.6	NO
2700.	1.687	5	4.0	4.0	5000.0	97.5	128.6	48.5	NO

4000.	1.871	5	2.0	2.0	5000.0	122.7	182.4	60.8	NO
4500.	1.901	5	2.0	2.0	5000.0	122.7	202.1	63.3	NO
5000.	1.914	5	2.0	2.0	5000.0	122.7	221.6	65.7	NO
5500.	1.931	5	1.0	1.0	5000.0	154.5	242.4	73.2	NO
6000.	1.969	5	1.0	1.0	5000.0	154.5	261.5	75.3	NO
6500.	1.997	5	1.0	1.0	5000.0	154.5	280.4	77.3	NO
7000.	2.015	5	1.0	1.0	5000.0	154.5	299.2	79.3	NO
7500.	2.026	5	1.0	1.0	5000.0	154.5	317.8	81.3	NO
8000.	2.031	5	1.0	1.0	5000.0	154.5	336.4	83.2	NO
8500.	2.029	5	1.0	1.0	5000.0	154.5	354.8	85.1	NO
9000.	2.024	5	1.0	1.0	5000.0	154.5	373.0	86.9	NO
9500.	2.014	5	1.0	1.0	5000.0	154.5	391.2	88.7	NO
10000.	2.002	5	1.0	1.0	5000.0	154.5	409.3	90.5	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

691.	4.311	4	20.0	20.0	5000.0	37.4	49.5	25.6	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
* SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *
* SIMPLE ELEVATED TERRAIN PROCEDURE *
****

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	4.311	691.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

flare - run A

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	FLARE
EMISSION RATE (G/S)	=	1.000
FLARE STACK HEIGHT (M)	=	.50
TOT HEAT RLS (CAL/S)	=	.1300E+08
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
EFF RELEASE HEIGHT (M)	=	11.97
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 215.54 M**4/S**3; MOM. FLUX = 131.43 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.1320	6	1.0	1.1	5000.0	155.1	41.1	41.0	NO
200.	.1363	6	1.0	1.1	5000.0	155.1	41.6	41.1	NO
300.	.1417	6	1.0	1.1	5000.0	155.1	42.4	41.3	NO
400.	.1482	6	1.0	1.1	5000.0	155.1	43.4	41.5	NO
500.	.3884	4	20.0	20.5	5000.0	56.8	37.1	20.1	NO
600.	.7691	4	20.0	20.5	5000.0	56.8	43.8	23.2	NO
700.	1.128	4	20.0	20.5	5000.0	56.8	50.3	26.2	NO
800.	1.403	4	20.0	20.5	5000.0	56.8	56.7	29.1	NO
900.	1.586	4	20.0	20.5	5000.0	56.8	63.1	32.0	NO
1000.	1.690	4	20.0	20.5	5000.0	56.8	69.4	34.8	NO
1100.	1.689	4	20.0	20.5	5000.0	56.8	75.5	36.7	NO
1200.	1.664	4	20.0	20.5	5000.0	56.8	81.6	38.5	NO
1300.	1.628	4	20.0	20.5	5000.0	56.8	87.6	40.3	NO
1400.	1.584	4	20.0	20.5	5000.0	56.8	93.5	42.1	NO
1500.	1.535	4	20.0	20.5	5000.0	56.8	99.5	43.8	NO
1600.	1.483	4	20.0	20.5	5000.0	56.8	105.4	45.5	NO
1700.	1.430	4	20.0	20.5	5000.0	56.8	111.2	47.1	NO
1800.	1.378	4	20.0	20.5	5000.0	56.8	117.1	48.8	NO
1900.	1.326	4	20.0	20.5	5000.0	56.8	122.9	50.4	NO
2000.	1.275	4	20.0	20.5	5000.0	56.8	128.7	51.9	NO
2100.	1.227	4	20.0	20.5	5000.0	56.8	134.4	53.5	NO
2200.	1.180	4	20.0	20.5	5000.0	56.8	140.1	55.0	NO
2300.	1.135	4	20.0	20.5	5000.0	56.8	145.8	56.5	NO
2400.	1.092	4	20.0	20.5	5000.0	56.8	151.5	58.0	NO
2500.	1.051	4	20.0	20.5	5000.0	56.8	157.2	59.5	NO
2600.	1.012	4	20.0	20.5	5000.0	56.8	162.8	60.9	NO
2700.	.9747	4	15.0	15.4	4800.0	74.1	168.8	63.5	NO
2800.	.9504	4	15.0	15.4	4800.0	74.1	174.4	64.8	NO
2900.	.9264	4	15.0	15.4	4800.0	74.1	180.0	66.2	NO
3000.	.9029	4	15.0	15.4	4800.0	74.1	185.5	67.6	NO
3500.	.7938	4	15.0	15.4	4800.0	74.1	213.0	73.7	NO

4000.	.8174	5	4.0	4.3	5000.0	121.9	181.8	58.9	NO
4500.	.8498	5	3.0	3.2	5000.0	133.0	202.1	63.1	NO
5000.	.8772	5	3.0	3.2	5000.0	133.0	221.6	65.6	NO
5500.	.9033	5	2.0	2.1	5000.0	150.5	241.7	70.6	NO
6000.	.9290	5	2.0	2.1	5000.0	150.5	260.8	72.8	NO
6500.	.9484	5	2.0	2.1	5000.0	150.5	279.8	74.9	N
7000.	.9625	5	2.0	2.1	5000.0	150.5	298.6	77.0	N
7500.	.9777	5	1.0	1.1	5000.0	186.5	318.7	84.6	NO
8000.	1.002	5	1.0	1.1	5000.0	186.5	337.2	86.5	NO
8500.	1.023	5	1.0	1.1	5000.0	186.5	355.5	88.3	NO
9000.	1.040	5	1.0	1.1	5000.0	186.5	373.8	90.0	NO
9500.	1.055	5	1.0	1.1	5000.0	186.5	391.9	91.8	NO
10000.	1.066	5	1.0	1.1	5000.0	186.5	410.0	93.5	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1021.	1.695	4	20.0	20.5	5000.0	56.8	70.7	35.2	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*******************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *
*     SIMPLE ELEVATED TERRAIN PROCEDURE   *
*******************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	1.695	1021.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

10-06-94
08:05:43

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

flare - run B

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = FLARE
EMISSION RATE (G/S) = 1.000
FLARE STACK HEIGHT (M) = .50
TOT HEAT RLS (CAL/S) = .6600E+08
RECEPTOR HEIGHT (M) = .00
IOPT (1=URB,2=RUR) = 2
EFF RELEASE HEIGHT (M) = 25.43
BUILDING HEIGHT (M) = .00
MIN HORIZ BLDG DIM (M) = .00
MAX HORIZ BLDG DIM (M) = .00

BUOY. FLUX = 1094.28 M**4/S**3; MOM. FLUX = 667.28 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.2174E-01	6	1.0	1.7	5000.0	239.6	60.9	60.8	NO
200.	.2570E-01	5	1.0	1.4	5000.0	300.1	79.3	78.7	NO
300.	.2643E-01	5	1.0	1.4	5000.0	300.1	80.3	79.0	NO
400.	.2721E-01	5	1.0	1.4	5000.0	300.1	81.5	79.2	NO
500.	.2808E-01	5	1.0	1.4	5000.0	300.1	83.0	79.5	NO
600.	.2903E-01	5	1.0	1.4	5000.0	300.1	84.7	79.8	NO
700.	.3007E-01	5	1.0	1.4	5000.0	300.1	86.7	80.2	NO
800.	.4480E-01	1	3.0	3.2	960.0	830.4	213.2	310.1	NO
900.	.1320	1	3.0	3.2	960.0	830.4	234.5	388.2	NO
1000.	.2395	1	3.0	3.2	960.0	830.4	255.3	477.1	NO
1100.	.3267	1	3.0	3.2	960.0	830.4	275.9	577.0	NO
1200.	.3749	1	3.0	3.2	960.0	830.4	296.1	687.9	NO
1300.	.3884	1	3.0	3.2	960.0	830.4	316.0	810.0	NO
1400.	.3806	1	3.0	3.2	960.0	830.4	335.6	943.3	NO
1500.	.3643	1	3.0	3.2	960.0	830.4	355.0	1087.8	NO
1600.	.3466	1	3.0	3.2	960.0	830.4	374.2	1243.7	NO
1700.	.3300	1	3.0	3.2	960.0	830.4	393.2	1411.0	NO
1800.	.3163	1	2.0	2.1	1234.0	1233.0	478.5	1608.3	NO
1900.	.3034	1	2.0	2.1	1234.0	1233.0	499.1	1797.9	NO
2000.	.2935	1	2.0	2.1	1234.0	1233.0	515.9	1998.2	NO
2100.	.2865	1	2.0	2.1	1234.0	1233.0	528.5	2209.4	NO
2200.	.2798	1	2.0	2.1	1234.0	1233.0	541.2	2432.7	NO
2300.	.2733	1	2.0	2.1	1234.0	1233.0	554.0	2668.1	NO
2400.	.2671	1	2.0	2.1	1234.0	1233.0	566.9	2915.6	NO
2500.	.2611	1	2.0	2.1	1234.0	1233.0	579.9	3175.2	NO
2600.	.2553	1	2.0	2.1	1234.0	1233.0	593.0	3446.9	NO
2700.	.2498	1	2.0	2.1	1234.0	1233.0	606.2	3730.8	NO
2800.	.2444	1	2.0	2.1	1234.0	1233.0	619.5	4026.9	NO
2900.	.2393	1	2.0	2.1	1234.0	1233.0	632.8	4335.1	NO
3000.	.2343	1	2.0	2.1	1234.0	1233.0	646.2	4655.7	NO
3500.	.2122	1	2.0	2.1	1234.0	1233.0	713.6	5000.0	NO

4000.	.2028	4	20.0	23.0	5000.0	130.7	241.4	83.8	NO
4500.	.1978	4	20.0	23.0	5000.0	130.7	268.0	89.2	NO
5000.	.1908	4	20.0	23.0	5000.0	130.7	294.2	94.3	NO
5500.	.1829	4	20.0	23.0	5000.0	130.7	320.2	99.3	NO
6000.	.1747	4	20.0	23.0	5000.0	130.7	345.9	104.1	NO
6500.	.1664	4	20.0	23.0	5000.0	130.7	371.4	108.8	NO
7000.	.1583	4	20.0	23.0	5000.0	130.7	396.7	113.3	NO
7500.	.1505	4	20.0	23.0	5000.0	130.7	421.8	117.8	NO
8000.	.1431	4	20.0	23.0	5000.0	130.7	446.7	122.1	NO
8500.	.1454	5	5.0	6.9	5000.0	186.1	355.0	86.1	NO
9000.	.1490	5	5.0	6.9	5000.0	186.1	373.3	87.9	NO
9500.	.1526	5	4.0	5.5	5000.0	198.5	391.9	91.5	NO
10000.	.1560	5	4.0	5.5	5000.0	198.5	409.9	93.3	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1302.	.3884	1	3.0	3.2	960.0	830.4	316.2	811.3	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
* SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *
* SIMPLE ELEVATED TERRAIN PROCEDURE *
****

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.3884	1302.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

ATTACHMENT F-1-C

OB SCREEN MODELING RUNS

(for Section F-1.6)

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 1

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE             =    POINT
   EMISSION RATE (G/S)     =    1.000
   STACK HEIGHT (M)        =      .00
   STK INSIDE DIAM (M)     =     3.00
   STK EXIT VELOCITY (M/S)=     10.00
   STK GAS EXIT TEMP (K)   =  1000.00
   AMBIENT AIR TEMP (K)    =   293.00
   RECEPTOR HEIGHT (M)     =      .00
   IOPT (1=URB,2=RUR)      =     2
   BUILDING HEIGHT (M)     =      .00
   MIN HORIZ BLDG DIM (M) =       .00
   MAX HORIZ BLDG DIM (M) =       .00
```

BUOY. FLUX = 155.99 M**4/S**3; MOM. FLUX = 65.93 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.4913	6	1.0	1.0	5000.0	132.8	38.2	38.0	NO
200.	.5058	6	1.0	1.0	5000.0	132.8	38.7	38.2	NO
300.	.5485	4	20.0	20.0	5000.0	40.1	23.3	13.3	NO
400.	1.761	4	20.0	20.0	5000.0	40.1	30.2	16.7	NO
500.	2.841	4	20.0	20.0	5000.0	40.1	37.0	19.9	NO
600.	3.467	4	20.0	20.0	5000.0	40.1	43.6	22.9	NO
700.	3.711	4	20.0	20.0	5000.0	40.1	50.1	25.9	NO
800.	3.714	4	20.0	20.0	5000.0	40.1	56.6	28.8	NO
900.	3.585	4	20.0	20.0	5000.0	40.1	62.9	31.6	NO
1000.	3.388	4	20.0	20.0	5000.0	40.1	69.1	34.1	NO
1100.	3.166	4	20.0	20.0	5000.0	40.1	75.2	36.0	NO
1200.	2.956	4	20.0	20.0	5000.0	40.1	81.2	37.9	NO
1300.	2.761	4	20.0	20.0	5000.0	40.1	87.3	39.7	NO
1400.	2.581	4	20.0	20.0	5000.0	40.1	93.3	41.5	NO
1500.	2.416	4	20.0	20.0	5000.0	40.1	99.2	43.2	NO
1600.	2.265	4	20.0	20.0	5000.0	40.1	105.1	44.9	NO
1700.	2.132	4	15.0	15.0	4800.0	53.4	111.5	47.7	NO
1800.	2.041	4	15.0	15.0	4800.0	53.4	117.3	49.3	NO
1900.	1.953	4	15.0	15.0	4800.0	53.4	123.1	50.9	NO
2000.	1.870	4	15.0	15.0	4800.0	53.4	128.9	52.4	NO
2100.	1.790	4	15.0	15.0	4800.0	53.4	134.6	54.0	NO
2200.	1.715	4	15.0	15.0	4800.0	53.4	140.3	55.5	NO
2300.	1.644	4	15.0	15.0	4800.0	53.4	146.0	57.0	NO
2400.	1.577	4	15.0	15.0	4800.0	53.4	151.7	58.4	NO
2500.	1.513	4	15.0	15.0	4800.0	53.4	157.3	59.9	NO
2600.	1.522	5	5.0	5.0	5000.0	93.6	124.3	47.2	NO
2700.	1.537	5	5.0	5.0	5000.0	93.6	128.4	47.9	NO
2800.	1.549	5	5.0	5.0	5000.0	93.6	132.5	48.6	NO
2900.	1.564	5	4.0	4.0	5000.0	100.8	137.0	50.4	NO

3500.	1.641	5	3.0	3.0	5000.0	110.9	161.9	56.0	NO
4000.	1.689	5	3.0	3.0	5000.0	110.9	181.8	59.0	NO
4500.	1.723	5	2.0	2.0	5000.0	127.0	202.4	64.1	NO
5000.	1.741	5	2.0	2.0	5000.0	127.0	221.8	66.5	NO
5500.	1.746	5	2.0	2.0	5000.0	127.0	241.2	68.8	NO
6000.	1.768	5	1.0	1.0	5000.0	160.0	261.8	76.3	NO
6500.	1.797	5	1.0	1.0	5000.0	160.0	280.7	78.3	NO
7000.	1.819	5	1.0	1.0	5000.0	160.0	299.4	80.3	NO
7500.	1.834	5	1.0	1.0	5000.0	160.0	318.1	82.2	NO
8000.	1.843	5	1.0	1.0	5000.0	160.0	336.6	84.1	NO
8500.	1.847	5	1.0	1.0	5000.0	160.0	355.0	86.0	NO
9000.	1.847	5	1.0	1.0	5000.0	160.0	373.3	87.8	NO
9500.	1.842	5	1.0	1.0	5000.0	160.0	391.4	89.6	NO
10000.	1.835	5	1.0	1.0	5000.0	160.0	409.5	91.3	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

749.	3.735	4	20.0	20.0	5000.0	40.1	53.4	27.4	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	3.735	749.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 2

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE            =    POINT
   EMISSION RATE (G/S)    =    1.000
   STACK HEIGHT (M)       =      .50
   STK INSIDE DIAM (M)    =     3.00
   STK EXIT VELOCITY (M/S)=    10.00
   STK GAS EXIT TEMP (K)  =  1000.00
   AMBIENT AIR TEMP (K)   =   293.00
   RECEPTOR HEIGHT (M)    =      .00
   IOPT (1=URB,2=RUR)     =     2
   BUILDING HEIGHT (M)    =      .00
   MIN HORIZ BLDG DIM (M) =      .00
   MAX HORIZ BLDG DIM (M) =      .00
```

BUOY. FLUX = 155.99 M**4/S**3; MOM. FLUX = 65.93 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.4692	6	1.0	1.0	5000.0	133.3	38.2	38.0	NO
200.	.4832	6	1.0	1.0	5000.0	133.3	38.7	38.2	NO
300.	.5485	4	20.0	20.0	5000.0	40.1	23.3	13.3	NO
400.	1.761	4	20.0	20.0	5000.0	40.1	30.2	16.7	NO
500.	2.841	4	20.0	20.0	5000.0	40.1	37.0	19.9	NO
600.	3.467	4	20.0	20.0	5000.0	40.1	43.6	22.9	NO
700.	3.711	4	20.0	20.0	5000.0	40.1	50.1	25.9	NO
800.	3.714	4	20.0	20.0	5000.0	40.1	56.6	28.8	NO
900.	3.585	4	20.0	20.0	5000.0	40.1	62.9	31.6	NO
1000.	3.388	4	20.0	20.0	5000.0	40.1	69.1	34.1	NO
1100.	3.166	4	20.0	20.0	5000.0	40.1	75.2	36.0	NO
1200.	2.956	4	20.0	20.0	5000.0	40.1	81.2	37.9	NO
1300.	2.761	4	20.0	20.0	5000.0	40.1	87.3	39.7	NO
1400.	2.581	4	20.0	20.0	5000.0	40.1	93.3	41.5	NO
1500.	2.416	4	20.0	20.0	5000.0	40.1	99.2	43.2	NO
1600.	2.265	4	20.0	20.0	5000.0	40.1	105.1	44.9	NO
1700.	2.132	4	15.0	15.0	4800.0	53.4	111.5	47.7	NO
1800.	2.041	4	15.0	15.0	4800.0	53.4	117.3	49.3	NO
1900.	1.953	4	15.0	15.0	4800.0	53.4	123.1	50.9	NO
2000.	1.870	4	15.0	15.0	4800.0	53.4	128.9	52.4	NO
2100.	1.790	4	15.0	15.0	4800.0	53.4	134.6	54.0	NO
2200.	1.715	4	15.0	15.0	4800.0	53.4	140.3	55.5	NO
2300.	1.644	4	15.0	15.0	4800.0	53.4	146.0	57.0	NO
2400.	1.577	4	15.0	15.0	4800.0	53.4	151.7	58.4	NO
2500.	1.513	4	15.0	15.0	4800.0	53.4	157.3	59.9	NO
2600.	1.490	5	5.0	5.0	5000.0	94.1	124.3	47.2	NO
2700.	1.506	5	5.0	5.0	5000.0	94.1	128.4	47.9	NO
2800.	1.519	5	5.0	5.0	5000.0	94.1	132.5	48.6	NO
2900.	1.577	5	4.0	4.0	5000.0	101.7	177.0	50.4	NO

3500.	1.612	5	3.0	3.0	5000.0	111.4	161.9	56.0	NO
4000.	1.662	5	3.0	3.0	5000.0	111.4	181.8	59.0	NO
4500.	1.696	5	2.0	2.0	5000.0	127.5	202.4	64.1	NO
5000.	1.716	5	2.0	2.0	5000.0	127.5	221.8	66.5	NO
5500.	1.723	5	2.0	2.0	5000.0	127.5	241.2	68.8	NO
6000.	1.744	5	1.0	1.0	5000.0	160.5	261.8	76.3	NO
6500.	1.774	5	1.0	1.0	5000.0	160.5	280.7	78.3	NO
7000.	1.797	5	1.0	1.0	5000.0	160.5	299.4	80.3	NO
7500.	1.813	5	1.0	1.0	5000.0	160.5	318.1	82.2	NO
8000.	1.822	5	1.0	1.0	5000.0	160.5	336.6	84.1	NO
8500.	1.827	5	1.0	1.0	5000.0	160.5	355.0	86.0	NO
9000.	1.827	5	1.0	1.0	5000.0	160.5	373.3	87.8	NO
9500.	1.824	5	1.0	1.0	5000.0	160.5	391.4	89.6	NO
10000.	1.817	5	1.0	1.0	5000.0	160.5	409.5	91.3	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

749.	3.735	4	20.0	20.0	5000.0	40.1	53.4	27.4	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
*********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	3.735	749.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

10-07-94
10:31:17

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 3

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	1.00
STK EXIT VELOCITY (M/S)	=	10.00
STK GAS EXIT TEMP (K)	=	1000.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 17.33 M**4/S**3; MOM. FLUX = 7.32 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	67.05	4	20.0	20.0	5000.0	9.1	8.3	4.8	NO
200.	67.48	4	20.0	20.0	5000.0	9.1	15.7	8.7	NO
300.	46.32	4	15.0	15.0	4800.0	12.1	22.9	12.6	NO
400.	34.91	4	10.0	10.0	3200.0	18.2	29.9	16.1	NO
500.	28.99	4	10.0	10.0	3200.0	18.2	36.5	19.0	NO
600.	24.54	4	8.0	8.0	2560.0	22.7	43.2	22.2	NO
700.	21.22	4	8.0	8.0	2560.0	22.7	49.6	24.9	NO
800.	18.35	4	8.0	8.0	2560.0	22.7	56.0	27.6	NO
900.	16.47	4	5.0	5.0	1600.0	36.4	62.8	31.2	NO
1000.	15.30	4	5.0	5.0	1600.0	36.4	68.9	33.7	NO
1100.	14.13	4	5.0	5.0	1600.0	36.4	75.0	35.7	NO
1200.	13.07	4	5.0	5.0	1600.0	36.4	81.1	37.6	NO
1300.	12.10	4	5.0	5.0	1600.0	36.4	87.1	39.4	NO
1400.	12.33	6	4.0	4.0	5000.0	40.2	47.5	20.7	NO
1500.	12.63	6	3.0	3.0	5000.0	44.3	50.6	22.0	NO
1600.	12.96	6	3.0	3.0	5000.0	44.3	53.5	22.6	NO
1700.	13.23	6	3.0	3.0	5000.0	44.3	56.4	23.3	NO
1800.	13.49	6	2.0	2.0	5000.0	50.7	59.7	24.9	NO
1900.	13.81	6	2.0	2.0	5000.0	50.7	62.5	25.5	NO
2000.	14.08	6	2.0	2.0	5000.0	50.7	65.3	26.0	NO
2100.	14.20	6	2.0	2.0	5000.0	50.7	68.1	26.5	NO
2200.	14.28	6	2.0	2.0	5000.0	50.7	70.9	27.0	NO
2300.	14.34	6	2.0	2.0	5000.0	50.7	73.7	27.5	NO
2400.	14.38	6	2.0	2.0	5000.0	50.7	76.5	27.9	NO
2500.	14.56	6	1.0	1.0	5000.0	63.8	80.1	30.5	NO
2600.	14.74	6	1.0	1.0	5000.0	63.8	82.8	30.9	NO
2700.	14.90	6	1.0	1.0	5000.0	63.8	85.5	31.3	NO
2800.	15.04	6	1.0	1.0	5000.0	63.8	88.3	31.7	NO
2900.	15.17	6	1.0	1.0	5000.0	63.8	91.0	[illegible]	NO

3500.	15.26	6	1.0	1.0	5000.0	63.8	107.2	34.2	NO
4000.	15.07	6	1.0	1.0	5000.0	63.8	120.6	35.8	NO
4500.	14.78	6	1.0	1.0	5000.0	63.8	133.8	37.3	NO
5000.	14.42	6	1.0	1.0	5000.0	63.8	146.8	38.8	NO
5500.	14.02	6	1.0	1.0	5000.0	63.8	159.7	40.1	NO
6000.	13.60	6	1.0	1.0	5000.0	63.8	172.5	41.5	NO
6500.	13.18	6	1.0	1.0	5000.0	63.8	185.2	42.7	NO
7000.	12.76	6	1.0	1.0	5000.0	63.8	197.8	44.0	NO
7500.	12.30	6	1.0	1.0	5000.0	63.8	210.3	45.0	NO
8000.	11.87	6	1.0	1.0	5000.0	63.8	222.7	46.0	NO
8500.	11.47	6	1.0	1.0	5000.0	63.8	235.0	47.0	NO
9000.	11.08	6	1.0	1.0	5000.0	63.8	247.3	48.0	NO
9500.	10.71	6	1.0	1.0	5000.0	63.8	259.4	48.9	NO
10000.	10.36	6	1.0	1.0	5000.0	63.8	271.5	49.8	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

137.	80.50	4	20.0	20.0	5000.0	9.1	11.2	6.4	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*     SIMPLE ELEVATED TERRAIN PROCEDURE     *
*********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	80.50	137.	0.

```
****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 4

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	3.00
STK EXIT VELOCITY (M/S)	=	10.00
STK GAS EXIT TEMP (K)	=	1000.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 155.99 M**4/S**3; MOM. FLUX = 65.93 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.4913	6	1.0	1.0	5000.0	132.8	38.2	38.0	NO
200.	.5058	6	1.0	1.0	5000.0	132.8	38.7	38.2	NO
300.	.5485	4	20.0	20.0	5000.0	40.1	23.3	13.3	NO
400.	1.761	4	20.0	20.0	5000.0	40.1	30.2	16.7	NO
500.	2.841	4	20.0	20.0	5000.0	40.1	37.0	19.9	NO
600.	3.467	4	20.0	20.0	5000.0	40.1	43.6	22.9	NO
700.	3.711	4	20.0	20.0	5000.0	40.1	50.1	25.9	NO
800.	3.714	4	20.0	20.0	5000.0	40.1	56.6	28.8	NO
900.	3.585	4	20.0	20.0	5000.0	40.1	62.9	31.6	NO
1000.	3.388	4	20.0	20.0	5000.0	40.1	69.1	34.1	NO
1100.	3.166	4	20.0	20.0	5000.0	40.1	75.2	36.0	NO
1200.	2.956	4	20.0	20.0	5000.0	40.1	81.2	37.9	NO
1300.	2.761	4	20.0	20.0	5000.0	40.1	87.3	39.7	NO
1400.	2.581	4	20.0	20.0	5000.0	40.1	93.3	41.5	NO
1500.	2.416	4	20.0	20.0	5000.0	40.1	99.2	43.2	NO
1600.	2.265	4	20.0	20.0	5000.0	40.1	105.1	44.9	NO
1700.	2.132	4	15.0	15.0	4800.0	53.4	111.5	47.7	NO
1800.	2.041	4	15.0	15.0	4800.0	53.4	117.3	49.3	NO
1900.	1.953	4	15.0	15.0	4800.0	53.4	123.1	50.9	NO
2000.	1.870	4	15.0	15.0	4800.0	53.4	128.9	52.4	NO
2100.	1.790	4	15.0	15.0	4800.0	53.4	134.6	54.0	NO
2200.	1.715	4	15.0	15.0	4800.0	53.4	140.3	55.5	NO
2300.	1.644	4	15.0	15.0	4800.0	53.4	146.0	57.0	NO
2400.	1.577	4	15.0	15.0	4800.0	53.4	151.7	58.4	NO
2500.	1.513	4	15.0	15.0	4800.0	53.4	157.3	59.9	NO
2600.	1.522	5	5.0	5.0	5000.0	93.6	124.3	47.2	NO
2700.	1.537	5	5.0	5.0	5000.0	93.6	128.4	47.9	NO
2800.	1.549	5	5.0	5.0	5000.0	93.6	132.5	48.6	NO
2900.	1.564	5	4.0	4.0	5000.0	[illegible]	[illegible]	[illegible]	NO

3500.	1.641	5	3.0	3.0	5000.0	110.9	161.9	56.0	NO
4000.	1.689	5	3.0	3.0	5000.0	110.9	181.8	59.0	NO
4500.	1.723	5	2.0	2.0	5000.0	127.0	202.4	64.1	NO
5000.	1.741	5	2.0	2.0	5000.0	127.0	221.8	66.5	NO
5500.	1.746	5	2.0	2.0	5000.0	127.0	241.2	68.8	NO
6000.	1.768	5	1.0	1.0	5000.0	160.0	261.8	76.3	NO
6500.	1.797	5	1.0	1.0	5000.0	160.0	280.7	78.3	NO
7000.	1.819	5	1.0	1.0	5000.0	160.0	299.4	80.3	NO
7500.	1.834	5	1.0	1.0	5000.0	160.0	318.1	82.2	NO
8000.	1.843	5	1.0	1.0	5000.0	160.0	336.6	84.1	NO
8500.	1.847	5	1.0	1.0	5000.0	160.0	355.0	86.0	NO
9000.	1.847	5	1.0	1.0	5000.0	160.0	373.3	87.8	NO
9500.	1.842	5	1.0	1.0	5000.0	160.0	391.4	89.6	NO
10000.	1.835	5	1.0	1.0	5000.0	160.0	409.5	91.3	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

749.	3.735	4	20.0	20.0	5000.0	40.1	53.4	27.4	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
* SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *
* SIMPLE ELEVATED TERRAIN PROCEDURE *
****

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	3.735	749.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

```
 *** SCREEN-1.1 MODEL RUN ***
 *** VERSION DATED  88300 ***

non-flare case, RUN 5

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE             =   POINT
   EMISSION RATE (G/S)     =    1.000
   STACK HEIGHT (M)        =      .00
   STK INSIDE DIAM (M)     =    10.00
   STK EXIT VELOCITY (M/S)=    10.00
   STK GAS EXIT TEMP (K)   =  1000.00
   AMBIENT AIR TEMP (K)    =   293.00
   RECEPTOR HEIGHT (M)     =      .00
   IOPT (1=URB,2=RUR)      =     2
   BUILDING HEIGHT (M)     =      .00
   MIN HORIZ BLDG DIM (M) =      .00
   MAX HORIZ BLDG DIM (M) =      .00


BUOY. FLUX = 1733.21 M**4/S**3;  MOM. FLUX =  732.50 M**4/S**2.

*** FULL METEOROLOGY ***

**********************************
*** SCREEN AUTOMATED DISTANCES ***
**********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.9747E-01	6	1.0	1.0	5000.0	296.3	84.7	84.7	NO
200.	.9805E-01	6	1.0	1.0	5000.0	296.3	85.0	84.7	NO
300.	.9874E-01	6	1.0	1.0	5000.0	296.3	85.4	84.8	NO
400.	.9953E-01	6	1.0	1.0	5000.0	296.3	85.9	84.9	NO
500.	.1004	6	1.0	1.0	5000.0	296.3	86.5	85.1	NO
600.	.1014	6	1.0	1.0	5000.0	296.3	87.3	85.2	NO
700.	.1024	6	1.0	1.0	5000.0	296.3	88.1	85.4	NO
800.	.1031	6	1.0	1.0	5000.0	296.3	89.0	85.5	NO
900.	.1039	6	1.0	1.0	5000.0	296.3	90.1	85.6	NO
1000.	.1069	1	3.0	3.0	1133.4	1132.4	277.6	489.4	NO
1100.	.1886	1	3.0	3.0	1133.4	1132.4	299.3	588.6	NO
1200.	.2542	1	3.0	3.0	1133.4	1132.4	320.6	698.9	NO
1300.	.2917	1	3.0	3.0	1133.4	1132.4	341.6	820.3	NO
1400.	.3041	1	3.0	3.0	1133.4	1132.4	362.2	953.1	NO
1500.	.3006	1	3.0	3.0	1133.4	1132.4	382.7	1097.1	NO
1600.	.2899	1	3.0	3.0	1133.4	1132.4	402.8	1252.6	NO
1700.	.2773	1	3.0	3.0	1133.4	1132.4	422.7	1419.5	NO
1800.	.2652	1	3.0	3.0	1133.4	1132.4	442.4	1597.9	NO
1900.	.2540	1	3.0	3.0	1133.4	1132.4	461.9	1787.9	NO
2000.	.2438	1	3.0	3.0	1133.4	1132.4	481.2	1989.5	NO
2100.	.2345	1	3.0	3.0	1133.4	1132.4	500.4	2202.9	NO
2200.	.2259	1	3.0	3.0	1133.4	1132.4	519.3	2428.0	NO
2300.	.2180	1	3.0	3.0	1133.4	1132.4	538.1	2664.9	NO
2400.	.2117	1	3.0	3.0	1133.4	1132.4	554.1	2913.1	NO
2500.	.2068	1	3.0	3.0	1133.4	1132.4	567.4	3172.9	NO
2600.	.2020	1	3.0	3.0	1133.4	1132.4	580.8	3444.8	NO
2700.	.1974	1	3.0	3.0	1133.4	1132.4	594.3	3728.9	NO
2800.	.1930	1	3.0	3.0	1133.4	1132.4	607.8	4025.1	NO
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	NO

3500.	.1668	1	3.0	3.0	1133.4	1132.4	703.5	5000.0	NO
4000.	.1519	1	3.0	3.0	1133.4	1132.4	772.4	5000.0	NO
4500.	.1395	1	3.0	3.0	1133.4	1132.4	841.3	5000.0	NO
5000.	.1304	5	5.0	5.0	5000.0	208.8	226.8	81.6	NO
5500.	.1363	5	5.0	5.0	5000.0	208.8	245.8	83.5	NO
6000.	.1417	5	5.0	5.0	5000.0	208.8	264.6	85.4	NO
6500.	.1466	5	5.0	5.0	5000.0	208.8	283.3	87.2	NO
7000.	.1511	5	5.0	5.0	5000.0	208.8	301.9	89.0	NO
7500.	.1551	5	5.0	5.0	5000.0	208.8	320.4	90.7	NO
8000.	.1587	5	5.0	5.0	5000.0	208.8	338.8	92.5	NO
8500.	.1620	5	5.0	5.0	5000.0	208.8	357.0	94.1	NO
9000.	.1648	5	5.0	5.0	5000.0	208.8	375.2	95.8	NO
9500.	.1673	5	5.0	5.0	5000.0	208.8	393.3	97.4	NO
10000.	.1694	5	5.0	5.0	5000.0	208.8	411.3	99.1	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1419.	.3044	1	3.0	3.0	1133.4	1132.4	365.9	978.2	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
*********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
****************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
****************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.3044	1419.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 6

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	3.00
STK EXIT VELOCITY (M/S)	=	.01
STK GAS EXIT TEMP (K)	=	1000.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = .16 M**4/S**3; MOM. FLUX = .00 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	4321.	4	1.0	1.0	320.0	5.3	8.3	4.9	NO
200.	1950.	4	1.0	1.0	320.0	5.3	15.6	8.6	NO
300.	1048.	4	1.0	1.0	320.0	5.3	22.7	12.2	NO
400.	664.5	6	1.0	1.0	5000.0	13.3	15.1	8.0	NO
500.	666.1	6	1.0	1.0	5000.0	13.3	18.4	9.2	NO
600.	628.2	6	1.0	1.0	5000.0	13.3	21.6	10.4	NO
700.	575.4	6	1.0	1.0	5000.0	13.3	24.7	11.6	NO
800.	519.6	6	1.0	1.0	5000.0	13.3	27.9	12.6	NO
900.	468.8	6	1.0	1.0	5000.0	13.3	31.0	13.5	NO
1000.	423.6	6	1.0	1.0	5000.0	13.3	34.1	14.5	NO
1100.	384.2	6	1.0	1.0	5000.0	13.3	37.2	15.3	NO
1200.	350.0	6	1.0	1.0	5000.0	13.3	40.2	16.1	NO
1300.	320.1	6	1.0	1.0	5000.0	13.3	43.2	16.9	NO
1400.	294.0	6	1.0	1.0	5000.0	13.3	46.2	17.7	NO
1500.	271.0	6	1.0	1.0	5000.0	13.3	49.2	18.4	NO
1600.	250.6	6	1.0	1.0	5000.0	13.3	52.1	19.2	NO
1700.	232.6	6	1.0	1.0	5000.0	13.3	55.1	19.9	NO
1800.	216.6	6	1.0	1.0	5000.0	13.3	58.0	20.6	NO
1900.	202.2	6	1.0	1.0	5000.0	13.3	60.9	21.3	NO
2000.	189.3	6	1.0	1.0	5000.0	13.3	63.8	22.0	NO
2100.	178.1	6	1.0	1.0	5000.0	13.3	66.7	22.5	NO
2200.	168.0	6	1.0	1.0	5000.0	13.3	69.5	23.1	NO
2300.	158.9	6	1.0	1.0	5000.0	13.3	72.4	23.6	NO
2400.	150.5	6	1.0	1.0	5000.0	13.3	75.2	24.2	NO
2500.	142.8	6	1.0	1.0	5000.0	13.3	78.0	24.7	NO
2600.	135.8	6	1.0	1.0	5000.0	13.3	80.9	25.2	NO
2700.	129.4	6	1.0	1.0	5000.0	13.3	83.7	25.8	NO
2800.	123.4	6	1.0	1.0	5000.0	13.3	86.4	26.3	NO
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

3500.	92.92	6	1.0	1.0	5000.0	13.3	105.7	29.2	NO
4000.	78.43	6	1.0	1.0	5000.0	13.3	119.2	31.1	NO
4500.	67.47	6	1.0	1.0	5000.0	13.3	132.6	32.8	NO
5000.	58.92	6	1.0	1.0	5000.0	13.3	145.7	34.4	NO
5500.	52.09	6	1.0	1.0	5000.0	13.3	158.7	36.0	NO
6000.	46.54	6	1.0	1.0	5000.0	13.3	171.6	37.4	NO
6500.	41.93	6	1.0	1.0	5000.0	13.3	184.4	38.8	NO
7000.	38.07	6	1.0	1.0	5000.0	13.3	197.0	40.2	NO
7500.	34.90	6	1.0	1.0	5000.0	13.3	209.6	41.3	NO
8000.	32.16	6	1.0	1.0	5000.0	13.3	222.0	42.5	NO
8500.	29.79	6	1.0	1.0	5000.0	13.3	234.4	43.5	NO
9000.	27.71	6	1.0	1.0	5000.0	13.3	246.6	44.6	NO
9500.	25.87	6	1.0	1.0	5000.0	13.3	258.8	45.6	NO
10000.	24.24	6	1.0	1.0	5000.0	13.3	270.9	46.5	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

100.	4321.	4	1.0	1.0	320.0	5.3	8.3	4.9	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	4321.	100.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 7

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE            =    POINT
   EMISSION RATE (G/S)    =    1.000
   STACK HEIGHT (M)       =      .00
   STK INSIDE DIAM (M)    =     3.00
   STK EXIT VELOCITY (M/S)=      .10
   STK GAS EXIT TEMP (K)  =  1000.00
   AMBIENT AIR TEMP (K)   =   293.00
   RECEPTOR HEIGHT (M)    =      .00
   IOPT (1=URB,2=RUR)     =     2
   BUILDING HEIGHT (M)    =      .00
   MIN HORIZ BLDG DIM (M) =      .00
   MAX HORIZ BLDG DIM (M) =      .00
```

BUOY. FLUX = 1.56 M**4/S**3; MOM. FLUX = .01 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	741.8	4	8.0	8.0	2560.0	3.7	8.3	4.8	NO
200.	403.1	4	3.0	3.0	960.0	10.0	15.8	9.0	NO
300.	273.3	4	2.0	2.0	640.0	15.0	23.0	12.8	NO
400.	216.2	4	2.0	2.0	640.0	15.0	29.8	15.9	NO
500.	169.6	4	2.0	2.0	640.0	15.0	36.4	18.8	NO
600.	135.9	4	1.0	1.0	320.0	29.9	43.6	22.9	NO
700.	125.7	4	1.0	1.0	320.0	29.9	49.9	25.5	NO
800.	114.4	4	1.0	1.0	320.0	29.9	56.2	28.1	NO
900.	114.5	6	1.0	1.0	5000.0	28.6	31.8	15.3	NO
1000.	118.1	6	1.0	1.0	5000.0	28.6	34.9	16.2	NO
1100.	119.1	6	1.0	1.0	5000.0	28.6	37.9	16.9	NO
1200.	118.9	6	1.0	1.0	5000.0	28.6	40.8	17.7	NO
1300.	117.8	6	1.0	1.0	5000.0	28.6	43.8	18.4	NO
1400.	116.1	6	1.0	1.0	5000.0	28.6	46.8	19.1	NO
1500.	113.9	6	1.0	1.0	5000.0	28.6	49.7	19.8	NO
1600.	111.4	6	1.0	1.0	5000.0	28.6	52.6	20.5	NO
1700.	108.6	6	1.0	1.0	5000.0	28.6	55.5	21.2	NO
1800.	105.7	6	1.0	1.0	5000.0	28.6	58.4	21.8	NO
1900.	102.7	6	1.0	1.0	5000.0	28.6	61.3	22.5	NO
2000.	99.76	6	1.0	1.0	5000.0	28.6	64.2	23.1	NO
2100.	96.62	6	1.0	1.0	5000.0	28.6	67.1	23.7	NO
2200.	93.58	6	1.0	1.0	5000.0	28.6	69.9	24.2	NO
2300.	90.64	6	1.0	1.0	5000.0	28.6	72.7	24.7	NO
2400.	87.82	6	1.0	1.0	5000.0	28.6	75.6	25.2	NO
2500.	85.10	6	1.0	1.0	5000.0	28.6	78.4	25.8	NO
2600.	82.50	6	1.0	1.0	5000.0	28.6	81.2	26.3	NO
2700.	80.00	6	1.0	1.0	5000.0	28.6	84.0	26.7	NO
2800.	77.61	6	1.0	1.0	5000.0	28.6	86.8	27.2	NO
2900.	[illegible]	6	1.0	1.0	5000.0	[illegible]	[illegible]	[illegible]	NO

3500.	63.53	6	1.0	1.0	5000.0	28.6	106.0	30.1	NO
4000.	55.88	6	1.0	1.0	5000.0	28.6	119.4	31.9	NO
4500.	49.68	6	1.0	1.0	5000.0	28.6	132.8	33.6	NO
5000.	44.56	6	1.0	1.0	5000.0	28.6	145.9	35.2	NO
5500.	40.29	6	1.0	1.0	5000.0	28.6	158.9	36.7	NO
6000.	36.68	6	1.0	1.0	5000.0	28.6	171.8	38.1	NO
6500.	33.60	6	1.0	1.0	5000.0	28.6	184.5	39.5	NO
7000.	30.94	6	1.0	1.0	5000.0	28.6	197.2	40.8	NO
7500.	28.67	6	1.0	1.0	5000.0	28.6	209.7	42.0	NO
8000.	26.69	6	1.0	1.0	5000.0	28.6	222.1	43.1	NO
8500.	24.94	6	1.0	1.0	5000.0	28.6	234.5	44.1	NO
9000.	23.38	6	1.0	1.0	5000.0	28.6	246.7	45.1	NO
9500.	21.99	6	1.0	1.0	5000.0	28.6	258.9	46.1	NO
10000.	20.74	6	1.0	1.0	5000.0	28.6	271.0	47.1	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

100.	741.8	4	8.0	8.0	2560.0	3.7	8.3	4.8	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
* SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *
* SIMPLE ELEVATED TERRAIN PROCEDURE *
****

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	741.8	100.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

10-07-94
10:31:30

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 8

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	3.00
STK EXIT VELOCITY (M/S)	=	1.00
STK GAS EXIT TEMP (K)	=	1000.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 15.60 M**4/S**3; MOM. FLUX = .66 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	86.62	4	20.0	20.0	5000.0	8.4	8.3	4.8	NO
200.	73.10	4	20.0	20.0	5000.0	8.4	15.7	8.7	NO
300.	49.71	4	15.0	15.0	4800.0	11.2	22.8	12.5	NO
400.	38.37	4	10.0	10.0	3200.0	16.8	29.8	16.0	NO
500.	31.08	4	10.0	10.0	3200.0	16.8	36.5	18.9	NO
600.	26.56	4	8.0	8.0	2560.0	21.0	43.1	22.0	NO
700.	22.61	4	8.0	8.0	2560.0	21.0	49.6	24.8	NO
800.	19.73	4	5.0	5.0	1600.0	33.6	56.4	28.5	NO
900.	18.20	4	5.0	5.0	1600.0	33.6	62.6	31.0	NO
1000.	16.69	4	5.0	5.0	1600.0	33.6	68.8	33.5	NO
1100.	15.28	4	5.0	5.0	1600.0	33.6	74.9	35.5	NO
1200.	14.03	4	5.0	5.0	1600.0	33.6	81.0	37.3	NO
1300.	13.34	6	4.0	4.0	5000.0	38.8	44.4	19.9	NO
1400.	13.67	6	4.0	4.0	5000.0	38.8	47.4	20.5	NO
1500.	14.06	6	3.0	3.0	5000.0	42.7	50.5	21.8	NO
1600.	14.38	6	3.0	3.0	5000.0	42.7	53.4	22.4	NO
1700.	14.67	6	2.0	2.0	5000.0	48.9	56.7	24.0	NO
1800.	15.04	6	2.0	2.0	5000.0	48.9	59.5	24.6	NO
1900.	15.35	6	2.0	2.0	5000.0	48.9	62.4	25.2	NO
2000.	15.61	6	2.0	2.0	5000.0	48.9	65.2	25.7	NO
2100.	15.70	6	2.0	2.0	5000.0	48.9	68.0	26.2	NO
2200.	15.75	6	2.0	2.0	5000.0	48.9	70.8	26.7	NO
2300.	15.87	6	1.0	1.0	5000.0	61.6	74.4	29.2	NO
2400.	16.09	6	1.0	1.0	5000.0	61.6	77.2	29.7	NO
2500.	16.29	6	1.0	1.0	5000.0	61.6	79.9	30.1	NO
2600.	16.46	6	1.0	1.0	5000.0	61.6	82.7	30.5	NO
2700.	16.61	6	1.0	1.0	5000.0	61.6	85.4	31.0	NO
2800.	16.74	6	1.0	1.0	5000.0	61.6	88.1	31.4	NO
2900.	16.85	6	1.0	1.0	5000.0	61.6	[illegible]	[illegible]	NO

3500.	16.81	6	1.0	1.0	5000.0	61.6	107.1	33.9	NO
4000.	16.50	6	1.0	1.0	5000.0	61.6	120.5	35.5	NO
4500.	16.10	6	1.0	1.0	5000.0	61.6	133.7	37.0	NO
5000.	15.63	6	1.0	1.0	5000.0	61.6	146.7	38.5	NO
5500.	15.14	6	1.0	1.0	5000.0	61.6	159.7	39.9	NO
6000.	14.63	6	1.0	1.0	5000.0	61.6	172.5	41.2	NO
6500.	14.12	6	1.0	1.0	5000.0	61.6	185.2	42.5	NO
7000.	13.63	6	1.0	1.0	5000.0	61.6	197.8	43.7	NO
7500.	13.11	6	1.0	1.0	5000.0	61.6	210.3	44.8	NO
8000.	12.62	6	1.0	1.0	5000.0	61.6	222.7	45.8	NO
8500.	12.16	6	1.0	1.0	5000.0	61.6	235.0	46.8	NO
9000.	11.73	6	1.0	1.0	5000.0	61.6	247.2	47.8	NO
9500.	11.31	6	1.0	1.0	5000.0	61.6	259.4	48.7	NO
10000.	10.93	6	1.0	1.0	5000.0	61.6	271.5	49.6	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

125.	94.67	4	20.0	20.0	5000.0	8.4	10.3	5.9	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
* SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *
* SIMPLE ELEVATED TERRAIN PROCEDURE *
****

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	94.67	125.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 9

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE              =    POINT
   EMISSION RATE (G/S)      =    1.000
   STACK HEIGHT (M)         =      .00
   STK INSIDE DIAM (M)      =     3.00
   STK EXIT VELOCITY (M/S)=       3.00
   STK GAS EXIT TEMP (K)  =    1000.00
   AMBIENT AIR TEMP (K)     =   293.00
   RECEPTOR HEIGHT (M)      =      .00
   IOPT (1=URB,2=RUR)       =     2
   BUILDING HEIGHT (M)      =      .00
   MIN HORIZ BLDG DIM (M) =        .00
   MAX HORIZ BLDG DIM (M) =        .00
```

BUOY. FLUX =   46.80 M**4/S**3; MOM. FLUX =   5.93 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF   0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	1.117	6	1.0	1.0	5000.0	88.9	25.7	25.5	NO
200.	11.37	4	20.0	20.0	5000.0	19.2	15.8	9.0	NO
300.	17.41	4	20.0	20.0	5000.0	19.2	22.9	12.6	NO
400.	16.25	4	20.0	20.0	5000.0	19.2	29.8	15.9	NO
500.	13.79	4	20.0	20.0	5000.0	19.2	36.5	19.0	NO
600.	11.50	4	20.0	20.0	5000.0	19.2	43.1	21.9	NO
700.	10.13	4	15.0	15.0	4800.0	25.6	49.7	25.1	NO
800.	8.927	4	15.0	15.0	4800.0	25.6	56.1	27.8	NO
900.	7.871	4	15.0	15.0	4800.0	25.6	62.3	30.4	NO
1000.	7.181	4	10.0	10.0	3200.0	38.3	69.0	33.9	NO
1100.	6.673	4	10.0	10.0	3200.0	38.3	75.1	35.8	NO
1200.	6.202	4	10.0	10.0	3200.0	38.3	81.2	37.7	NO
1300.	5.770	4	10.0	10.0	3200.0	38.3	87.2	39.5	NO
1400.	5.375	4	10.0	10.0	3200.0	38.3	93.2	41.3	NO
1500.	5.020	4	8.0	8.0	2560.0	47.9	99.5	43.9	NO
1600.	4.766	4	8.0	8.0	2560.0	47.9	105.4	45.5	NO
1700.	4.700	6	4.0	4.0	5000.0	56.0	57.2	25.2	NO
1800.	4.871	6	4.0	4.0	5000.0	56.0	60.0	25.8	NO
1900.	5.025	6	4.0	4.0	5000.0	56.0	62.8	26.3	NO
2000.	5.164	6	4.0	4.0	5000.0	56.0	65.7	26.9	NO
2100.	5.241	6	4.0	4.0	5000.0	56.0	68.5	27.4	NO
2200.	5.307	6	4.0	4.0	5000.0	56.0	71.2	27.8	NO
2300.	5.363	6	4.0	4.0	5000.0	56.0	74.0	28.3	NO
2400.	5.409	6	4.0	4.0	5000.0	56.0	76.8	28.7	NO
2500.	5.446	6	4.0	4.0	5000.0	56.0	79.6	29.2	NO
2600.	5.487	6	3.0	3.0	5000.0	61.6	82.7	30.5	NO
2700.	5.536	6	3.0	3.0	5000.0	61.6	85.4	31.0	NO
2800.	5.579	6	3.0	3.0	5000.0	61.6	88.1	31.4	NO
2900.	5.6[illegible]	6	3.0	3.0	5000.0	61.6	90.8	31.8	NO

3500.	5.691	6	2.0	2.0	5000.0	70.5	107.6	35.3	NO
4000.	5.714	6	2.0	2.0	5000.0	70.5	120.9	36.8	NO
4500.	5.686	6	2.0	2.0	5000.0	70.5	134.0	38.3	NO
5000.	5.733	6	1.0	1.0	5000.0	88.9	147.9	42.6	NO
5500.	5.793	6	1.0	1.0	5000.0	88.9	160.7	43.9	NO
6000.	5.824	6	1.0	1.0	5000.0	88.9	173.4	45.1	NO
6500.	5.833	6	1.0	1.0	5000.0	88.9	186.1	46.2	NO
7000.	5.822	6	1.0	1.0	5000.0	88.9	198.6	47.4	NO
7500.	5.762	6	1.0	1.0	5000.0	88.9	211.1	48.4	NO
8000.	5.695	6	1.0	1.0	5000.0	88.9	223.4	49.3	NO
8500.	5.622	6	1.0	1.0	5000.0	88.9	235.7	50.2	NO
9000.	5.546	6	1.0	1.0	5000.0	88.9	247.9	51.1	NO
9500.	5.468	6	1.0	1.0	5000.0	88.9	260.0	52.0	NO
10000.	5.387	6	1.0	1.0	5000.0	88.9	272.1	52.9	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

313.	17.46	4	20.0	20.0	5000.0	19.2	23.9	13.1	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR   *
*     SIMPLE ELEVATED TERRAIN PROCEDURE     *
*********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	17.46	313.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 10

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE             =    POINT
   EMISSION RATE (G/S)     =    1.000
   STACK HEIGHT (M)        =      .00
   STK INSIDE DIAM (M)     =     3.00
   STK EXIT VELOCITY (M/S)=     10.00
   STK GAS EXIT TEMP (K)   =  1000.00
   AMBIENT AIR TEMP (K)    =   293.00
   RECEPTOR HEIGHT (M)     =      .00
   IOPT (1=URB,2=RUR)      =     2
   BUILDING HEIGHT (M)     =      .00
   MIN HORIZ BLDG DIM (M) =       .00
   MAX HORIZ BLDG DIM (M) =       .00
```

BUOY. FLUX = 155.99 M**4/S**3; MOM. FLUX = 65.93 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.4913	6	1.0	1.0	5000.0	132.8	38.2	38.0	NO
200.	.5058	6	1.0	1.0	5000.0	132.8	38.7	38.2	NO
300.	.5485	4	20.0	20.0	5000.0	40.1	23.3	13.3	NO
400.	1.761	4	20.0	20.0	5000.0	40.1	30.2	16.7	NO
500.	2.841	4	20.0	20.0	5000.0	40.1	37.0	19.9	NO
600.	3.467	4	20.0	20.0	5000.0	40.1	43.6	22.9	NO
700.	3.711	4	20.0	20.0	5000.0	40.1	50.1	25.9	NO
800.	3.714	4	20.0	20.0	5000.0	40.1	56.6	28.8	NO
900.	3.585	4	20.0	20.0	5000.0	40.1	62.9	31.6	NO
1000.	3.388	4	20.0	20.0	5000.0	40.1	69.1	34.1	NO
1100.	3.166	4	20.0	20.0	5000.0	40.1	75.2	36.0	NO
1200.	2.956	4	20.0	20.0	5000.0	40.1	81.2	37.9	NO
1300.	2.761	4	20.0	20.0	5000.0	40.1	87.3	39.7	NO
1400.	2.581	4	20.0	20.0	5000.0	40.1	93.3	41.5	NO
1500.	2.416	4	20.0	20.0	5000.0	40.1	99.2	43.2	NO
1600.	2.265	4	20.0	20.0	5000.0	40.1	105.1	44.9	NO
1700.	2.132	4	15.0	15.0	4800.0	53.4	111.5	47.7	NO
1800.	2.041	4	15.0	15.0	4800.0	53.4	117.3	49.3	NO
1900.	1.953	4	15.0	15.0	4800.0	53.4	123.1	50.9	NO
2000.	1.870	4	15.0	15.0	4800.0	53.4	128.9	52.4	NO
2100.	1.790	4	15.0	15.0	4800.0	53.4	134.6	54.0	NO
2200.	1.715	4	15.0	15.0	4800.0	53.4	140.3	55.5	NO
2300.	1.644	4	15.0	15.0	4800.0	53.4	146.0	57.0	NO
2400.	1.577	4	15.0	15.0	4800.0	53.4	151.7	58.4	NO
2500.	1.513	4	15.0	15.0	4800.0	53.4	157.3	59.9	NO
2600.	1.522	5	5.0	5.0	5000.0	93.6	124.3	47.2	NO
2700.	1.537	5	5.0	5.0	5000.0	93.6	128.4	47.9	NO
2800.	1.549	5	5.0	5.0	5000.0	93.6	132.5	48.6	NO
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

3500.	1.641	5	3.0	3.0	5000.0	110.9	161.9	56.0	NO
4000.	1.689	5	3.0	3.0	5000.0	110.9	181.8	59.0	NO
4500.	1.723	5	2.0	2.0	5000.0	127.0	202.4	64.1	NO
5000.	1.741	5	2.0	2.0	5000.0	127.0	221.8	66.5	NO
5500.	1.746	5	2.0	2.0	5000.0	127.0	241.2	68.8	NO
6000.	1.768	5	1.0	1.0	5000.0	160.0	261.8	76.3	NO
6500.	1.797	5	1.0	1.0	5000.0	160.0	280.7	78.3	NO
7000.	1.819	5	1.0	1.0	5000.0	160.0	299.4	80.3	NO
7500.	1.834	5	1.0	1.0	5000.0	160.0	318.1	82.2	NO
8000.	1.843	5	1.0	1.0	5000.0	160.0	336.6	84.1	NO
8500.	1.847	5	1.0	1.0	5000.0	160.0	355.0	86.0	NO
9000.	1.847	5	1.0	1.0	5000.0	160.0	373.3	87.8	NO
9500.	1.842	5	1.0	1.0	5000.0	160.0	391.4	89.6	NO
10000.	1.835	5	1.0	1.0	5000.0	160.0	409.5	91.3	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

749.	3.735	4	20.0	20.0	5000.0	40.1	53.4	27.4	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
*********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	3.735	749.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 11

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE             =    POINT
   EMISSION RATE (G/S)     =    1.000
   STACK HEIGHT (M)        =      .00
   STK INSIDE DIAM (M)     =     3.00
   STK EXIT VELOCITY (M/S)=     20.00
   STK GAS EXIT TEMP (K)   =  1000.00
   AMBIENT AIR TEMP (K)    =   293.00
   RECEPTOR HEIGHT (M)     =      .00
   IOPT (1=URB,2=RUR)      =     2
   BUILDING HEIGHT (M)     =      .00
   MIN HORIZ BLDG DIM (M) =       .00
   MAX HORIZ BLDG DIM (M) =       .00
```

BUOY. FLUX = 311.98 M**4/S**3; MOM. FLUX = 263.70 M**4/S**2.

*** FULL METEOROLOGY ***

```
***********************************
*** SCREEN AUTOMATED DISTANCES ***
***********************************
```

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.3078	6	1.0	1.0	5000.0	167.3	48.0	47.9	NO
200.	.3135	6	1.0	1.0	5000.0	167.3	48.4	48.0	NO
300.	.3204	6	1.0	1.0	5000.0	167.3	49.1	48.1	NO
400.	.3285	6	1.0	1.0	5000.0	167.3	50.0	48.3	NO
500.	.3376	6	1.0	1.0	5000.0	167.3	51.1	48.5	NO
600.	.6002	4	20.0	20.0	5000.0	60.7	44.1	23.9	NO
700.	.9232	4	20.0	20.0	5000.0	60.7	50.7	27.0	NO
800.	1.189	4	20.0	20.0	5000.0	60.7	57.2	29.9	NO
900.	1.379	4	20.0	20.0	5000.0	60.7	63.5	32.8	NO
1000.	1.498	4	20.0	20.0	5000.0	60.7	69.9	35.6	NO
1100.	1.530	4	20.0	20.0	5000.0	60.7	76.1	37.9	NO
1200.	1.530	4	20.0	20.0	5000.0	60.7	82.3	40.0	NO
1300.	1.502	4	20.0	20.0	5000.0	60.7	88.2	41.8	NO
1400.	1.466	4	20.0	20.0	5000.0	60.7	94.2	43.5	NO
1500.	1.426	4	20.0	20.0	5000.0	60.7	100.1	45.1	NO
1600.	1.384	4	20.0	20.0	5000.0	60.7	105.9	46.8	NO
1700.	1.339	4	20.0	20.0	5000.0	60.7	111.8	48.4	NO
1800.	1.295	4	20.0	20.0	5000.0	60.7	117.6	50.0	NO
1900.	1.251	4	20.0	20.0	5000.0	60.7	123.4	51.5	NO
2000.	1.207	4	20.0	20.0	5000.0	60.7	129.1	53.1	NO
2100.	1.165	4	20.0	20.0	5000.0	60.7	134.8	54.6	NO
2200.	1.124	4	20.0	20.0	5000.0	60.7	140.6	56.1	NO
2300.	1.084	4	20.0	20.0	5000.0	60.7	146.2	57.6	NO
2400.	1.046	4	20.0	20.0	5000.0	60.7	151.9	59.0	NO
2500.	1.009	4	20.0	20.0	5000.0	60.7	157.5	60.4	NO
2600.	.9741	4	20.0	20.0	5000.0	60.7	163.2	61.9	NO
2700.	.9406	4	20.0	20.0	5000.0	60.7	168.8	63.3	NO
2800.	.9085	4	20.0	20.0	5000.0	60.7	174.3	64.7	NO
2900.	[illegible]	4	20.0	20.0	5000.0	60.7	179.8	[illegible]	NO

3500.	.8155	5	5.0	5.0	5000.0	117.9	162.3	57.1	NO
4000.	.8488	5	5.0	5.0	5000.0	117.9	182.2	60.1	NO
4500.	.8613	5	4.0	4.0	5000.0	127.0	202.4	64.1	NO
5000.	.8704	5	4.0	4.0	5000.0	127.0	221.8	66.5	NO
5500.	.8830	5	3.0	3.0	5000.0	139.8	241.7	70.8	NO
6000.	.8905	5	3.0	3.0	5000.0	139.8	260.8	73.0	NO
6500.	.8987	5	2.0	2.0	5000.0	160.0	280.7	78.3	NO
7000.	.9096	5	2.0	2.0	5000.0	160.0	299.4	80.3	NO
7500.	.9171	5	2.0	2.0	5000.0	160.0	318.1	82.2	NO
8000.	.9216	5	2.0	2.0	5000.0	160.0	336.6	84.1	NO
8500.	.9235	5	2.0	2.0	5000.0	160.0	355.0	86.0	NO
9000.	.9248	5	1.0	1.0	5000.0	201.6	374.9	94.5	NO
9500.	.9370	5	1.0	1.0	5000.0	201.6	393.0	96.2	NO
10000.	.9473	5	1.0	1.0	5000.0	201.6	411.0	97.8	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1162.	1.535	4	20.0	20.0	5000.0	60.7	79.9	39.3	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
* SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *
* SIMPLE ELEVATED TERRAIN PROCEDURE *
****

TERRAIN	DISTANCE RANGE (M)	
HT (M)	MINIMUM	MAXIMUM
0.	100.	10000.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	1.535	1162.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

10-07-94
10:31:40

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 12

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	3.00
STK EXIT VELOCITY (M/S)	=	10.00
STK GAS EXIT TEMP (K)	=	300.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 5.15 M**4/S**3; MOM. FLUX = 219.75 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	259.4	4	20.0	20.0	5000.0	4.5	8.2	4.7	NO
200.	136.0	4	10.0	10.0	3200.0	9.0	15.8	8.9	NO
300.	92.94	4	8.0	8.0	2560.0	11.3	22.8	12.5	NO
400.	70.80	4	5.0	5.0	1600.0	18.0	29.9	16.1	NO
500.	58.59	4	5.0	5.0	1600.0	18.0	36.5	19.0	NO
600.	49.65	4	4.0	4.0	1280.0	22.5	43.2	22.2	NO
700.	42.84	4	4.0	4.0	1280.0	22.5	49.6	24.9	NO
800.	37.98	4	3.0	3.0	960.0	30.0	56.2	28.1	NO
900.	34.84	6	3.0	3.0	5000.0	29.5	31.9	15.5	NO
1000.	36.61	6	2.0	2.0	5000.0	33.8	35.2	17.0	NO
1100.	37.94	6	2.0	2.0	5000.0	33.8	38.2	17.7	NO
1200.	38.86	6	2.0	2.0	5000.0	33.8	41.2	18.4	NO
1300.	39.97	6	1.0	1.0	5000.0	42.6	44.7	20.5	NO
1400.	41.42	6	1.0	1.0	5000.0	42.6	47.6	21.1	NO
1500.	42.61	6	1.0	1.0	5000.0	42.6	50.5	21.8	NO
1600.	43.55	6	1.0	1.0	5000.0	42.6	53.4	22.4	NO
1700.	44.28	6	1.0	1.0	5000.0	42.6	56.3	23.0	NO
1800.	44.81	6	1.0	1.0	5000.0	42.6	59.1	23.6	NO
1900.	45.17	6	1.0	1.0	5000.0	42.6	62.0	24.2	NO
2000.	45.37	6	1.0	1.0	5000.0	42.6	64.8	24.8	NO
2100.	45.17	6	1.0	1.0	5000.0	42.6	67.7	25.3	NO
2200.	44.90	6	1.0	1.0	5000.0	42.6	70.5	25.8	NO
2300.	44.56	6	1.0	1.0	5000.0	42.6	73.3	26.3	NO
2400.	44.17	6	1.0	1.0	5000.0	42.6	76.1	26.8	NO
2500.	43.74	6	1.0	1.0	5000.0	42.6	78.9	27.3	NO
2600.	43.28	6	1.0	1.0	5000.0	42.6	81.7	27.8	NO
2700.	42.78	6	1.0	1.0	5000.0	42.6	84.5	28.2	NO
2800.	42.27	6	1.0	1.0	5000.0	42.6	87.2	28.7	NO

3500.	38.03	6	1.0	1.0	5000.0	42.6	106.4	31.4	NO
4000.	35.12	6	1.0	1.0	5000.0	42.6	119.8	33.2	NO
4500.	32.50	6	1.0	1.0	5000.0	42.6	133.1	34.8	NO
5000.	30.14	6	1.0	1.0	5000.0	42.6	146.2	36.3	NO
5500.	28.04	6	1.0	1.0	5000.0	42.6	159.2	37.8	NO
6000.	26.16	6	1.0	1.0	5000.0	42.6	172.0	39.2	NO
6500.	24.48	6	1.0	1.0	5000.0	42.6	184.7	40.5	NO
7000.	22.96	6	1.0	1.0	5000.0	42.6	197.4	41.8	NO
7500.	21.60	6	1.0	1.0	5000.0	42.6	209.9	42.9	NO
8000.	20.37	6	1.0	1.0	5000.0	42.6	222.3	44.0	NO
8500.	19.26	6	1.0	1.0	5000.0	42.6	234.7	45.0	NO
9000.	18.25	6	1.0	1.0	5000.0	42.6	246.9	46.0	NO
9500.	17.34	6	1.0	1.0	5000.0	42.6	259.1	47.0	NO
10000.	16.50	6	1.0	1.0	5000.0	42.6	271.2	48.0	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

100.	259.4	4	20.0	20.0	5000.0	4.5	8.2	4.7	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
* SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *
* SIMPLE ELEVATED TERRAIN PROCEDURE *
****

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	259.4	100.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 13

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	3.00
STK EXIT VELOCITY (M/S)	=	10.00
STK GAS EXIT TEMP (K)	=	700.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 128.28 M**4/S**3; MOM. FLUX = 94.18 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.5609	6	1.0	1.0	5000.0	124.4	35.8	35.6	NO
200.	.5798	6	1.0	1.0	5000.0	124.4	36.4	35.8	NO
300.	1.331	4	20.0	20.0	5000.0	35.6	23.2	13.2	NO
400.	3.117	4	20.0	20.0	5000.0	35.6	30.1	16.5	NO
500.	4.266	4	20.0	20.0	5000.0	35.6	36.9	19.7	NO
600.	4.718	4	20.0	20.0	5000.0	35.6	43.5	22.7	NO
700.	4.737	4	20.0	20.0	5000.0	35.6	50.0	25.7	NO
800.	4.536	4	20.0	20.0	5000.0	35.6	56.5	28.6	NO
900.	4.238	4	20.0	20.0	5000.0	35.6	62.7	31.2	NO
1000.	3.921	4	20.0	20.0	5000.0	35.6	68.9	33.7	NO
1100.	3.613	4	20.0	20.0	5000.0	35.6	75.0	35.6	NO
1200.	3.334	4	20.0	20.0	5000.0	35.6	81.1	37.5	NO
1300.	3.082	4	20.0	20.0	5000.0	35.6	87.1	39.3	NO
1400.	2.856	4	20.0	20.0	5000.0	35.6	93.1	41.1	NO
1500.	2.706	4	15.0	15.0	4800.0	47.5	99.5	43.8	NO
1600.	2.567	4	15.0	15.0	4800.0	47.5	105.4	45.5	NO
1700.	2.436	4	15.0	15.0	4800.0	47.5	111.2	47.2	NO
1800.	2.313	4	15.0	15.0	4800.0	47.5	117.1	48.8	NO
1900.	2.198	4	15.0	15.0	4800.0	47.5	122.9	50.4	NO
2000.	2.090	4	15.0	15.0	4800.0	47.5	128.7	52.0	NO
2100.	1.990	4	15.0	15.0	4800.0	47.5	134.4	53.5	NO
2200.	1.896	4	15.0	15.0	4800.0	47.5	140.1	55.0	NO
2300.	1.809	4	15.0	15.0	4800.0	47.5	145.8	56.5	NO
2400.	1.814	5	5.0	5.0	5000.0	87.7	115.6	44.8	NO
2500.	1.831	5	5.0	5.0	5000.0	87.7	119.8	45.5	NO
2600.	1.850	5	4.0	4.0	5000.0	94.4	124.3	47.3	NO
2700.	1.879	6	4.0	4.0	5000.0	78.4	86.5	33.9	NO
2800.	1.912	6	4.0	4.0	5000.0	78.4	89.2	34.3	NO
2900.	1.943	6	4.0	4.0	5000.0	78.4	[illegible]	[illegible]	NO

3500.	2.039	6	4.0	4.0	5000.0	78.4	108.0	36.6	NO
4000.	2.079	6	4.0	4.0	5000.0	78.4	121.3	38.1	NO
4500.	2.099	6	4.0	4.0	5000.0	78.4	134.4	39.5	NO
5000.	2.104	6	4.0	4.0	5000.0	78.4	147.4	40.9	NO
5500.	2.135	5	1.0	1.0	5000.0	149.9	242.2	72.5	NO
6000.	2.169	5	1.0	1.0	5000.0	149.9	261.3	74.6	NO
6500.	2.192	5	1.0	1.0	5000.0	149.9	280.2	76.7	NO
7000.	2.205	5	1.0	1.0	5000.0	149.9	299.0	78.7	NO
7500.	2.210	5	1.0	1.0	5000.0	149.9	317.7	80.7	NO
8000.	2.209	5	1.0	1.0	5000.0	149.9	336.2	82.6	NO
8500.	2.202	5	1.0	1.0	5000.0	149.9	354.6	84.5	NO
9000.	2.190	5	1.0	1.0	5000.0	149.9	372.9	86.3	NO
9500.	2.175	5	1.0	1.0	5000.0	149.9	391.1	88.2	NO
10000.	2.156	5	1.0	1.0	5000.0	149.9	409.2	89.9	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

653.	4.767	4	20.0	20.0	5000.0	35.6	47.0	24.3	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	4.767	653.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 14

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 1.000
STACK HEIGHT (M) = .00
STK INSIDE DIAM (M) = 3.00
STK EXIT VELOCITY (M/S)= 10.00
STK GAS EXIT TEMP (K) = 1000.00
AMBIENT AIR TEMP (K) = 293.00
RECEPTOR HEIGHT (M) = .00
IOPT (1=URB,2=RUR) = 2
BUILDING HEIGHT (M) = .00
MIN HORIZ BLDG DIM (M) = .00
MAX HORIZ BLDG DIM (M) = .00

BUOY. FLUX = 155.99 M**4/S**3; MOM. FLUX = 65.93 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.4913	6	1.0	1.0	5000.0	132.8	38.2	38.0	NO
200.	.5058	6	1.0	1.0	5000.0	132.8	38.7	38.2	NO
300.	.5485	4	20.0	20.0	5000.0	40.1	23.3	13.3	NO
400.	1.761	4	20.0	20.0	5000.0	40.1	30.2	16.7	NO
500.	2.841	4	20.0	20.0	5000.0	40.1	37.0	19.9	NO
600.	3.467	4	20.0	20.0	5000.0	40.1	43.6	22.9	NO
700.	3.711	4	20.0	20.0	5000.0	40.1	50.1	25.9	NO
800.	3.714	4	20.0	20.0	5000.0	40.1	56.6	28.8	NO
900.	3.585	4	20.0	20.0	5000.0	40.1	62.9	31.6	NO
1000.	3.388	4	20.0	20.0	5000.0	40.1	69.1	34.1	NO
1100.	3.166	4	20.0	20.0	5000.0	40.1	75.2	36.0	NO
1200.	2.956	4	20.0	20.0	5000.0	40.1	81.2	37.9	NO
1300.	2.761	4	20.0	20.0	5000.0	40.1	87.3	39.7	NO
1400.	2.581	4	20.0	20.0	5000.0	40.1	93.3	41.5	NO
1500.	2.416	4	20.0	20.0	5000.0	40.1	99.2	43.2	NO
1600.	2.265	4	20.0	20.0	5000.0	40.1	105.1	44.9	NO
1700.	2.132	4	15.0	15.0	4800.0	53.4	111.5	47.7	NO
1800.	2.041	4	15.0	15.0	4800.0	53.4	117.3	49.3	NO
1900.	1.953	4	15.0	15.0	4800.0	53.4	123.1	50.9	NO
2000.	1.870	4	15.0	15.0	4800.0	53.4	128.9	52.4	NO
2100.	1.790	4	15.0	15.0	4800.0	53.4	134.6	54.0	NO
2200.	1.715	4	15.0	15.0	4800.0	53.4	140.3	55.5	NO
2300.	1.644	4	15.0	15.0	4800.0	53.4	146.0	57.0	NO
2400.	1.577	4	15.0	15.0	4800.0	53.4	151.7	58.4	NO
2500.	1.513	4	15.0	15.0	4800.0	53.4	157.3	59.9	NO
2600.	1.522	5	5.0	5.0	5000.0	93.6	124.3	47.2	NO
2700.	1.537	5	5.0	5.0	5000.0	93.6	128.4	47.9	NO
2800.	1.549	5	5.0	5.0	5000.0	93.6	132.5	48.6	NO
2900.	1.564	5	4.0	4.0	5000.0	100.8	137.0	50.4	NO

3500.	1.641	5	3.0	3.0	5000.0	110.9	161.9	56.0	NO
4000.	1.689	5	3.0	3.0	5000.0	110.9	181.8	59.0	NO
4500.	1.723	5	2.0	2.0	5000.0	127.0	202.4	64.1	NO
5000.	1.741	5	2.0	2.0	5000.0	127.0	221.8	66.5	NO
5500.	1.746	5	2.0	2.0	5000.0	127.0	241.2	68.8	NO
6000.	1.768	5	1.0	1.0	5000.0	160.0	261.8	76.3	NO
6500.	1.797	5	1.0	1.0	5000.0	160.0	280.7	78.3	NO
7000.	1.819	5	1.0	1.0	5000.0	160.0	299.4	80.3	NO
7500.	1.834	5	1.0	1.0	5000.0	160.0	318.1	82.2	NO
8000.	1.843	5	1.0	1.0	5000.0	160.0	336.6	84.1	NO
8500.	1.847	5	1.0	1.0	5000.0	160.0	355.0	86.0	NO
9000.	1.847	5	1.0	1.0	5000.0	160.0	373.3	87.8	NO
9500.	1.842	5	1.0	1.0	5000.0	160.0	391.4	89.6	NO
10000.	1.835	5	1.0	1.0	5000.0	160.0	409.5	91.3	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

749.	3.735	4	20.0	20.0	5000.0	40.1	53.4	27.4	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
*********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
****************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
****************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	3.735	749.	0.

```
*****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
*****************************************************
```

10-07-94
10:31:48

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 15

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	3.00
STK EXIT VELOCITY (M/S)	=	10.00
STK GAS EXIT TEMP (K)	=	1500.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 177.54 M**4/S**3; MOM. FLUX = 43.95 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.4502	6	1.0	1.0	5000.0	138.6	39.8	39.7	NO
200.	.4623	6	1.0	1.0	5000.0	138.6	40.4	39.8	NO
300.	.4772	6	1.0	1.0	5000.0	138.6	41.2	40.0	NO
400.	1.127	4	20.0	20.0	5000.0	43.3	30.3	16.8	NO
500.	2.067	4	20.0	20.0	5000.0	43.3	37.0	20.0	NO
600.	2.724	4	20.0	20.0	5000.0	43.3	43.7	23.1	NO
700.	3.065	4	20.0	20.0	5000.0	43.3	50.2	26.1	NO
800.	3.176	4	20.0	20.0	5000.0	43.3	56.7	29.0	NO
900.	3.144	4	20.0	20.0	5000.0	43.3	63.0	31.8	NO
1000.	3.027	4	20.0	20.0	5000.0	43.3	69.2	34.4	NO
1100.	2.858	4	20.0	20.0	5000.0	43.3	75.3	36.3	NO
1200.	2.693	4	20.0	20.0	5000.0	43.3	81.4	38.2	NO
1300.	2.534	4	20.0	20.0	5000.0	43.3	87.4	40.0	NO
1400.	2.385	4	20.0	20.0	5000.0	43.3	93.4	41.7	NO
1500.	2.245	4	20.0	20.0	5000.0	43.3	99.3	43.5	NO
1600.	2.116	4	20.0	20.0	5000.0	43.3	105.2	45.2	NO
1700.	1.996	4	20.0	20.0	5000.0	43.3	111.1	46.8	NO
1800.	1.884	4	20.0	20.0	5000.0	43.3	116.9	48.5	NO
1900.	1.782	4	15.0	15.0	4800.0	57.7	123.2	51.2	NO
2000.	1.714	4	15.0	15.0	4800.0	57.7	129.0	52.8	NO
2100.	1.649	4	15.0	15.0	4800.0	57.7	134.7	54.3	NO
2200.	1.586	4	15.0	15.0	4800.0	57.7	140.5	55.8	NO
2300.	1.526	4	15.0	15.0	4800.0	57.7	146.1	57.3	NO
2400.	1.468	4	15.0	15.0	4800.0	57.7	151.8	58.8	NO
2500.	1.414	4	15.0	15.0	4800.0	57.7	157.5	60.2	NO
2600.	1.362	4	15.0	15.0	4800.0	57.7	163.1	61.6	NO
2700.	1.348	5	5.0	5.0	5000.0	97.7	128.7	48.6	NO
2800.	1.362	5	5.0	5.0	5000.0	97.7	132.8	49.3	NO
2900.	1.375	5	5.0	5.0	5000.0	97.7	136.8	49.8	NO

3500.	1.439	5	4.0	4.0	5000.0	105.2	161.6	55.0	NO
4000.	1.491	5	3.0	3.0	5000.0	115.8	182.1	59.8	NO
4500.	1.509	5	2.0	2.0	5000.0	132.6	202.7	65.0	NO
5000.	1.533	5	2.0	2.0	5000.0	132.6	222.1	67.4	NO
5500.	1.547	5	2.0	2.0	5000.0	132.6	241.4	69.7	NO
6000.	1.550	5	2.0	2.0	5000.0	132.6	260.5	71.9	NO
6500.	1.568	5	1.0	1.0	5000.0	167.1	281.0	79.5	NO
7000.	1.593	5	1.0	1.0	5000.0	167.1	299.8	81.5	NO
7500.	1.612	5	1.0	1.0	5000.0	167.1	318.4	83.4	NO
8000.	1.625	5	1.0	1.0	5000.0	167.1	336.9	85.3	NO
8500.	1.634	5	1.0	1.0	5000.0	167.1	355.2	87.1	NO
9000.	1.639	5	1.0	1.0	5000.0	167.1	373.5	88.9	NO
9500.	1.640	5	1.0	1.0	5000.0	167.1	391.7	90.6	NO
10000.	1.639	5	1.0	1.0	5000.0	167.1	409.7	92.4	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

820.	3.179	4	20.0	20.0	5000.0	43.3	58.0	29.6	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
* SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *
* SIMPLE ELEVATED TERRAIN PROCEDURE *
****

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	3.179	820.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 16

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	3.00
STK EXIT VELOCITY (M/S)	=	10.00
STK GAS EXIT TEMP (K)	=	2000.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 188.31 M**4/S**3; MOM. FLUX = 32.96 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.4326	6	1.0	1.0	5000.0	141.4	40.6	40.5	NO
200.	.4438	6	1.0	1.0	5000.0	141.4	41.1	40.6	NO
300.	.4576	6	1.0	1.0	5000.0	141.4	41.9	40.8	NO
400.	.9011	4	20.0	20.0	5000.0	44.8	30.3	16.8	NO
500.	1.763	4	20.0	20.0	5000.0	44.8	37.1	20.1	NO
600.	2.413	4	20.0	20.0	5000.0	44.8	43.7	23.2	NO
700.	2.785	4	20.0	20.0	5000.0	44.8	50.3	26.2	NO
800.	2.937	4	20.0	20.0	5000.0	44.8	56.7	29.1	NO
900.	2.944	4	20.0	20.0	5000.0	44.8	63.1	31.9	NO
1000.	2.862	4	20.0	20.0	5000.0	44.8	69.3	34.6	NO
1100.	2.717	4	20.0	20.0	5000.0	44.8	75.4	36.5	NO
1200.	2.570	4	20.0	20.0	5000.0	44.8	81.5	38.3	NO
1300.	2.428	4	20.0	20.0	5000.0	44.8	87.5	40.1	NO
1400.	2.292	4	20.0	20.0	5000.0	44.8	93.4	41.9	NO
1500.	2.164	4	20.0	20.0	5000.0	44.8	99.4	43.6	NO
1600.	2.044	4	20.0	20.0	5000.0	44.8	105.3	45.3	NO
1700.	1.933	4	20.0	20.0	5000.0	44.8	111.1	46.9	NO
1800.	1.829	4	20.0	20.0	5000.0	44.8	117.0	48.6	NO
1900.	1.732	4	20.0	20.0	5000.0	44.8	122.8	50.2	NO
2000.	1.643	4	20.0	20.0	5000.0	44.8	128.6	51.8	NO
2100.	1.582	4	15.0	15.0	4800.0	59.8	134.8	54.5	NO
2200.	1.525	4	15.0	15.0	4800.0	59.8	140.5	56.0	NO
2300.	1.470	4	15.0	15.0	4800.0	59.8	146.2	57.5	NO
2400.	1.417	4	15.0	15.0	4800.0	59.8	151.9	58.9	NO
2500.	1.366	4	15.0	15.0	4800.0	59.8	157.5	60.4	NO
2600.	1.318	4	15.0	15.0	4800.0	59.8	163.1	61.8	NO
2700.	1.272	4	15.0	15.0	4800.0	59.8	168.7	63.2	NO
2800.	1.283	5	5.0	5.0	5000.0	99.6	132.9	49.6	NO
[illegible]	[illegible]	5	5.0	5.0	5000.0	[illegible]	[illegible]	[illegible]	NO

3500.	1.359	5	4.0	4.0	5000.0	107.3	161.7	55.4	NO
4000.	1.406	5	3.0	3.0	5000.0	118.1	182.2	60.1	NO
4500.	1.420	5	3.0	3.0	5000.0	118.1	201.9	62.7	NO
5000.	1.445	5	2.0	2.0	5000.0	135.2	222.2	67.8	NO
5500.	1.461	5	2.0	2.0	5000.0	135.2	241.5	70.1	NO
6000.	1.468	5	2.0	2.0	5000.0	135.2	260.6	72.3	NO
6500.	1.472	5	1.0	1.0	5000.0	170.4	281.2	80.1	NO
7000.	1.497	5	1.0	1.0	5000.0	170.4	299.9	82.0	NO
7500.	1.517	5	1.0	1.0	5000.0	170.4	318.5	83.9	NO
8000.	1.533	5	1.0	1.0	5000.0	170.4	337.0	85.8	NO
8500.	1.543	5	1.0	1.0	5000.0	170.4	355.4	87.6	NO
9000.	1.550	5	1.0	1.0	5000.0	170.4	373.6	89.4	NO
9500.	1.554	5	1.0	1.0	5000.0	170.4	391.8	91.1	NO
10000.	1.554	5	1.0	1.0	5000.0	170.4	409.8	92.9	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

855.	2.954	4	20.0	20.0	5000.0	44.8	60.3	30.7	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR   *
*     SIMPLE ELEVATED TERRAIN PROCEDURE     *
*********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	2.954	855.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 17

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	3.00
STK EXIT VELOCITY (M/S)	=	10.00
STK GAS EXIT TEMP (K)	=	1000.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 155.99 M**4/S**3; MOM. FLUX = 65.93 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.4913	6	1.0	1.0	5000.0	132.8	38.2	38.0	NO
200.	.5058	6	1.0	1.0	5000.0	132.8	38.7	38.2	NO
300.	.5485	4	20.0	20.0	5000.0	40.1	23.3	13.3	NO
400.	1.761	4	20.0	20.0	5000.0	40.1	30.2	16.7	NO
500.	2.841	4	20.0	20.0	5000.0	40.1	37.0	19.9	NO
600.	3.467	4	20.0	20.0	5000.0	40.1	43.6	22.9	NO
700.	3.711	4	20.0	20.0	5000.0	40.1	50.1	25.9	NO
800.	3.714	4	20.0	20.0	5000.0	40.1	56.6	28.8	NO
900.	3.585	4	20.0	20.0	5000.0	40.1	62.9	31.6	NO
1000.	3.388	4	20.0	20.0	5000.0	40.1	69.1	34.1	NO
1100.	3.166	4	20.0	20.0	5000.0	40.1	75.2	36.0	NO
1200.	2.956	4	20.0	20.0	5000.0	40.1	81.2	37.9	NO
1300.	2.761	4	20.0	20.0	5000.0	40.1	87.3	39.7	NO
1400.	2.581	4	20.0	20.0	5000.0	40.1	93.3	41.5	NO
1500.	2.416	4	20.0	20.0	5000.0	40.1	99.2	43.2	NO
1600.	2.265	4	20.0	20.0	5000.0	40.1	105.1	44.9	NO
1700.	2.132	4	15.0	15.0	4800.0	53.4	111.5	47.7	NO
1800.	2.041	4	15.0	15.0	4800.0	53.4	117.3	49.3	NO
1900.	1.953	4	15.0	15.0	4800.0	53.4	123.1	50.9	NO
2000.	1.870	4	15.0	15.0	4800.0	53.4	128.9	52.4	NO
2100.	1.790	4	15.0	15.0	4800.0	53.4	134.6	54.0	NO
2200.	1.715	4	15.0	15.0	4800.0	53.4	140.3	55.5	NO
2300.	1.644	4	15.0	15.0	4800.0	53.4	146.0	57.0	NO
2400.	1.577	4	15.0	15.0	4800.0	53.4	151.7	58.4	NO
2500.	1.513	4	15.0	15.0	4800.0	53.4	157.3	59.9	NO
2600.	1.522	5	5.0	5.0	5000.0	93.6	124.3	47.2	NO
2700.	1.537	5	5.0	5.0	5000.0	93.6	128.4	47.9	NO
2800.	1.549	5	5.0	5.0	5000.0	93.6	132.5	48.6	NO
2900.	1.564	5	4.0	4.0	5000.0	100.8	137.0	50.4	NO

3500.	1.641	5	3.0	3.0	5000.0	110.9	161.9	56.0	NO
4000.	1.689	5	3.0	3.0	5000.0	110.9	181.8	59.0	NO
4500.	1.723	5	2.0	2.0	5000.0	127.0	202.4	64.1	NO
5000.	1.741	5	2.0	2.0	5000.0	127.0	221.8	66.5	NO
5500.	1.746	5	2.0	2.0	5000.0	127.0	241.2	68.8	NO
6000.	1.768	5	1.0	1.0	5000.0	160.0	261.8	76.3	NO
6500.	1.797	5	1.0	1.0	5000.0	160.0	280.7	78.3	NO
7000.	1.819	5	1.0	1.0	5000.0	160.0	299.4	80.3	NO
7500.	1.834	5	1.0	1.0	5000.0	160.0	318.1	82.2	NO
8000.	1.843	5	1.0	1.0	5000.0	160.0	336.6	84.1	NO
8500.	1.847	5	1.0	1.0	5000.0	160.0	355.0	86.0	NO
9000.	1.847	5	1.0	1.0	5000.0	160.0	373.3	87.8	NO
9500.	1.842	5	1.0	1.0	5000.0	160.0	391.4	89.6	NO
10000.	1.835	5	1.0	1.0	5000.0	160.0	409.5	91.3	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

749.	3.735	4	20.0	20.0	5000.0	40.1	53.4	27.4	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	3.735	749.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

non-flare case, RUN 18

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	3.00
STK EXIT VELOCITY (M/S)	=	10.00
STK GAS EXIT TEMP (K)	=	1000.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	1.50
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 155.99 M**4/S**3; MOM. FLUX = 65.93 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.4956	6	1.0	1.0	5000.0	132.8	38.2	38.0	NO
200.	.5102	6	1.0	1.0	5000.0	132.8	38.7	38.2	NO
300.	.5769	4	20.0	20.0	5000.0	40.1	23.3	13.3	NO
400.	1.795	4	20.0	20.0	5000.0	40.1	30.2	16.7	NO
500.	2.866	4	20.0	20.0	5000.0	40.1	37.0	19.9	NO
600.	3.482	4	20.0	20.0	5000.0	40.1	43.6	22.9	NO
700.	3.719	4	20.0	20.0	5000.0	40.1	50.1	25.9	NO
800.	3.719	4	20.0	20.0	5000.0	40.1	56.6	28.8	NO
900.	3.587	4	20.0	20.0	5000.0	40.1	62.9	31.6	NO
1000.	3.389	4	20.0	20.0	5000.0	40.1	69.1	34.1	NO
1100.	3.167	4	20.0	20.0	5000.0	40.1	75.2	36.0	NO
1200.	2.957	4	20.0	20.0	5000.0	40.1	81.2	37.9	NO
1300.	2.761	4	20.0	20.0	5000.0	40.1	87.3	39.7	NO
1400.	2.581	4	20.0	20.0	5000.0	40.1	93.3	41.5	NO
1500.	2.416	4	20.0	20.0	5000.0	40.1	99.2	43.2	NO
1600.	2.265	4	20.0	20.0	5000.0	40.1	105.1	44.9	NO
1700.	2.133	4	15.0	15.0	4800.0	53.4	111.5	47.7	NO
1800.	2.041	4	15.0	15.0	4800.0	53.4	117.3	49.3	NO
1900.	1.953	4	15.0	15.0	4800.0	53.4	123.1	50.9	NO
2000.	1.870	4	15.0	15.0	4800.0	53.4	128.9	52.4	NO
2100.	1.790	4	15.0	15.0	4800.0	53.4	134.6	54.0	NO
2200.	1.715	4	15.0	15.0	4800.0	53.4	140.3	55.5	NO
2300.	1.644	4	15.0	15.0	4800.0	53.4	146.0	57.0	NO
2400.	1.577	4	15.0	15.0	4800.0	53.4	151.7	58.4	NO
2500.	1.513	4	15.0	15.0	4800.0	53.4	157.3	59.9	NO
2600.	1.524	5	5.0	5.0	5000.0	93.6	124.3	47.2	NO
2700.	1.539	5	5.0	5.0	5000.0	93.6	128.4	47.9	NO
2800.	1.551	5	5.0	5.0	5000.0	93.6	132.5	48.6	NO
[illegible]	[illegible]	5	[illegible]	[illegible]	5000.0	[illegible]	[illegible]	[illegible]	NO

3500.	1.644	6	4.0	4.0	5000.0	83.6	108.3	37.6	NO
4000.	1.690	6	4.0	4.0	5000.0	83.6	121.5	39.0	NO
4500.	1.724	5	2.0	2.0	5000.0	127.0	202.4	64.1	NO
5000.	1.742	5	2.0	2.0	5000.0	127.0	221.8	66.5	NO
5500.	1.747	5	2.0	2.0	5000.0	127.0	241.2	68.8	NO
6000.	1.769	5	1.0	1.0	5000.0	160.0	261.8	76.3	NO
6500.	1.799	5	1.0	1.0	5000.0	160.0	280.7	78.3	NO
7000.	1.820	5	1.0	1.0	5000.0	160.0	299.4	80.3	NO
7500.	1.835	5	1.0	1.0	5000.0	160.0	318.1	82.2	NO
8000.	1.844	5	1.0	1.0	5000.0	160.0	336.6	84.1	NO
8500.	1.848	5	1.0	1.0	5000.0	160.0	355.0	86.0	NO
9000.	1.847	5	1.0	1.0	5000.0	160.0	373.3	87.8	NO
9500.	1.843	5	1.0	1.0	5000.0	160.0	391.4	89.6	NO
10000.	1.835	5	1.0	1.0	5000.0	160.0	409.5	91.3	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

747.	3.741	4	20.0	20.0	5000.0	40.1	53.2	27.3	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	3.741	747.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

APPENDIX F-2

OD SOURCE SCENARIO DATA

APPENDIX F-2

OD SOURCE SCENARIO DATA

Table F-2 provides a summary of default OD source scenario value. Discussions of the basis for these values follow. Supporting POLU and SCREEN modeling output is provided in Attachments F-1-A and F-1-B.

F-2.1 INITIAL OD CLOUD DIMENSIONS

Default OD scenario values are provided in Table F-2.1-1. The initial volume of the OD cloud is assumed to be equal to the total volume (14.7 psi) of gases released. The POLU model provides a calculated estimate for the total gas volume released for various energetic material to air weight ratios. (Baroody and Tominack, January 1987; Baroody, April 1994). Table F-2.1-2 provides the maximum, average, and minimum volumes for TNT and composition C-4 based on POLU (Version 13L). Composition C-4 is frequently used as a donor charge and typically represents about half of the net explosive weight for an OD treatment event.

Table F-2.1-1. Default OD scenario values

Parameters	Default value
Source release height (m)	0.0
Source (stack) diameter (m)	Cloud diameter[a]
Exit velocity (m/s)	Selected to be less than or equal to DNA algorithm value for maximum concentrations conditions
Exit temperature (K)	800
Receptor height (m)	0.0
Initial cloud dimensions	
• Horizontal	Initial cloud (crater) diameter[a] at source (Eq. F-2.1-7)
• Vertical	Initial cloud top height[a] at source (Eq. F-2.1-6)

[a]Cloud dimensions based on a cylindrical volume source. Volume based on POLU predictions at 14.7 psi.

Table F-2.1-2. Total gas volume (at 14.7 psi) release based on POLU modeling - OD (m^3/kg)

Explosive	Maximum	Average	Minimum
TNT	7.6	2.4	1.1
C-4	7.8	2.4	1.1

The initial cloud radius can be estimated by two alternative methods. The first method is to assume the cloud is a sphere as follows:

$$v = \frac{4}{3} \; IT \; R^3 \qquad \text{Eq. F-2.1-1}$$

where

v = Cloud volume (m^3)

R = Cloud radius (m)

thus

$$R = \left[\frac{0.75 \; v}{IT} \right]^{1/3} \qquad \text{Eq. F-2.1-2}$$

Another approach is to assume the cloud is a cylinder with an initial diameter equivalent to that of the crater. This relationship can be expressed as:

$$v = IT \; R_c^2 \; H_{Ti} \qquad \text{Eq. F-2.1-3}$$

where

R_C = Radius of the OD crater (m)

H_{T_i} = Top of initial cloud (m)

and

$$R_{CR} = R \qquad \text{Eq. F-2.1-4}$$

and

$$D_{CR} = 2\ R_{CR} \qquad \text{Eq. F-2.1-5}$$

thus

$$H_{T_i} = \frac{v}{IT\ R_c^2} \qquad \text{Eq. F-2.1-6}$$

The crater diameter can be estimated based on the following (DNA, October 1983):

$$D_{CR} = (2.4)\ (V_{ac})^{1/3}\ (0.305) \qquad \text{Eq. F-2.1-7}$$

where

D_{CR} = Apparent crater diameter (m)

V_{ac} = Apparent crater volume (ft^3)

where

$$V_{ac} = V_{ce}\ x\ W_{gc}\ \exp\ [-5.2H_b\ (V_{ce}\ W_{gc})^{-0.33}] \qquad \text{Eq. F-2.1-8}$$

where

V_{ce} = Cratering efficiency for a zero height of burst based on Table 4.1.2.3.1-1 (ft^3/ton)

W_{gc} = TNT-equivalent net explosive weight relative to ground cratering (tons)

H_b = Height of the burst in feet; negative if below ground with soil cover (not applicable to more than a few charge radii below the surface)

and

$$W_{gc} = TF \; x \; W \qquad \text{Eq. F-2.1-9}$$

where

TF = TNT-equivalent weight factor relative to ground cratering efficiency, which is related to total energy content and not to detonation velocity

W = Net explosive weight detonation charge (tons)

The crater depth can be estimated as follows (DNA, October 1981):

$$D_a = (0.5) \; (V_{ac})^{1/3} \qquad \text{Eq. F-2.1-10}$$

where

D_a = Apparent crater depth (m)

A comparison of the resulting initial OD cloud dimensions is presented in Table F-2.1-3. The results from the alternative approaches are similar and the differences are considered insignificant. The crater depth is estimated to be about half of the initial cloud top height at the source. Observations indicate that the OD cloud can be characterized as a cylinder. (DNA, October 1981). Therefore, the initial OD cloud can be treated as a near-ground-level cylindrical source with the radius based on Eq. F-2.1-2.

Table F-2.1-3. Comparison of initial cloud dimensions

TNT-equivalent net explosion weight/tons	Cloud volume[a] (m^3)	Cloud diameter[b] (m^3)	Cloud top height (m)	Crater depth (m)
0.005 (10 lb)				
• Sphere	10.9	2.8	2.8	1.4
• Cylinder	10.9	2.0	3.5	1.4
0.05 (100 lb)				
• Sphere	109	5.9	5.9	2.9
• Cylinder	109	4.3	7.5	2.9
0.15 (300 lb)				
• Sphere	327	8.5	8.5	4.2
• Cylinder	327	6.2	10.8	4.2
0.5 (1,000 lb)				
• Sphere	1,090	12.8	12.8	6.3
• Cylinder	1,090	9.2	16.4	6.3
1.0 (2,000 lb)				
• Sphere	2,179	16.1	16.1	7.9
• Cylinder	2,179	11.6	20.1	7.9

[a]Based on POLU value of 2.4 m^3/kg for TNT and C-4 at 14.7 psi.
[b]Cloud diameter = crater diameter assuming a cratering efficiency of 4,000 ft^3/ton.

F-2.2 OD SOURCE TEMPERATURES AND EXIT VELOCITIES

The POLU model was developed by the U.S. Navy to simulate OB and OD source conditions. (Baroody and Tominack, January 1987; Baroody, April 1994). The model assumes that combustion gases will expand as the pressure drops from 1,000 to 14.7 psi. The flame temperature at 14.7 psi can be used as dispersion modeling input to determine cloud/plume rise. POLU provides plume temperature values for various energetic material to air ratios. Table F-2.2-1 provides the maximum, average, and minimum temperature for TNT and C-4. An OD source temperature of 800 K is considered a conservative default value as dispersion modeling input.

Because of the instantaneous nature of the OD detonation, it is difficult to estimate a reasonable heat flux to use the flare option of SCREEN.

Table F-2.2-1. Flame temperature at 14.7 psi based on POLU modeling - OD (K)

Explosive	Maximum	Average	Minimum
TNT	940	871	493
C-4	966	801	393

The stabilized OD cloud top height can be estimated using the following DNA equation:

$$H_{CT} = (508)\ (W')^{0.25} \qquad \text{Eq. F-2.2-1}$$

where

H_{CT} = Stabilized cloud top height (m)

W' = TNT-equivalent explosive weight (tons)

Based on the DNA approach, the OD stabilized cloud center height can be estimated as follows:

$$H_{CC} = (0.75)\ (H_{CT}) \qquad \text{Eq. F-2.2-2}$$

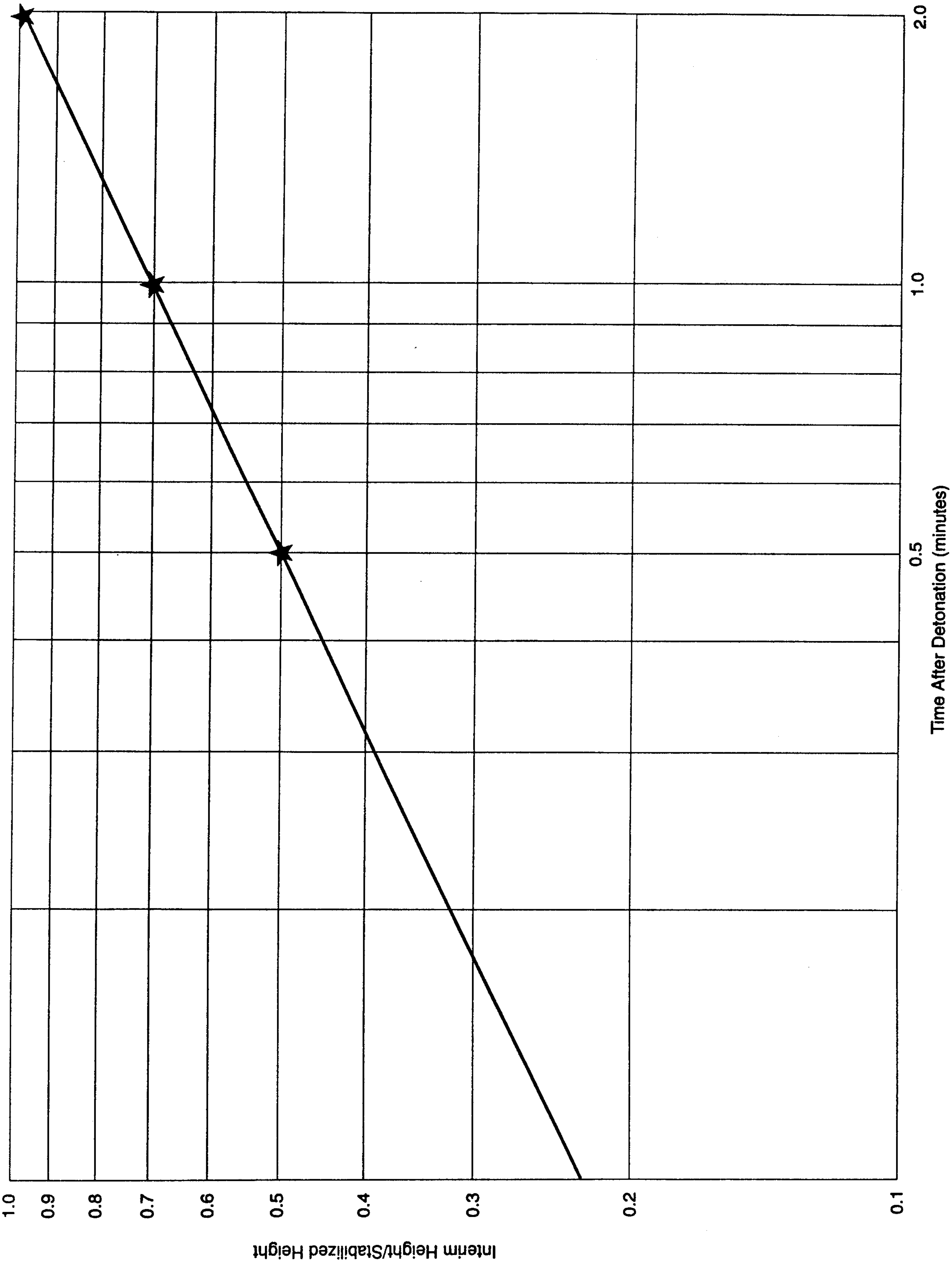
where

H_{CC} = Stabilized cloud center height (m)

The DNA (October 1981) algorithm for the stabilized OD cloud height has been based on a study conducted by Church (May 1969). The DNA information is presented in Appendix F-2.4 and the Church document in Appendix F-2.5. This involved an evaluation of 23 surface detonations. Quantities detonated ranged from 118 to 2,800 lbs net explosive weight. Average meteorological conditions during the detonation tests were slightly stable (i.e., "E" stability, corresponding to average lapse rate of 0.2°C/100 m) and moderate wind speeds (i.e., 5.6 m/s average).

The DNA stabilized OD cloud height should be used to select the appropriate OD exit velocity to calibrate the cloud height calculations of the dispersion model. This is accomplished by multiple preliminary screening dispersion modeling scenarios for hypothetical exit velocities ranging from 0.1 to 10 m/s. The meteorological conditions for these scenarios should correspond to the average DNA field test conditions (i.e., "E" stability and a 5.6 m/s wind speed). Based on these modeling results, an exit velocity should be selected which results in an OD stabilized cloud center height that is less than or equal to the DNA value determined from Eq. F-2.2-2. The selected exit velocity should be used for subsequent screening assessments.

Cloud heights for OD tests were observed to stabilize approximately 2 minutes after the detonations. Typically, based on the average of all tests, the interim cloud height to stabilized cloud height ratio was 0.5 at 30 s after the detonation and 0.7 at 1 min. These results did not vary significantly as a function of atmospheric stability. A plot of cloud height versus time after detonation is presented in Figure F-2.2-1. These adjustment factors should be used to reduce the cloud height for receptor distances less than those where the stabilized height is reached.


Time After Detonation (minutes)
2.0
1.0
0.5
Interim Height/Stabilized Height
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

F-2.3 OD SOURCE TERM SENSITIVITY ANALYSIS

A sensitivity analysis was conducted using the SCREEN model (nonflare) for a range of source conditions. These results are summarized in Table F-2.3-1 based on the "full meteorology" data set of SCREEN. This meterological set includes some conditions (stable as well as high wind speeds) during which OD operations are generally not conducted based on Army policy.

Following are the key conclusions from the sensitivity analysis:

- Release height: Maximum concentration and cloud height not significantly different for 0-20 m release height range.
- Source (stack) diameter: Variation in diameter from 2-20 m results in significant changes in maximum concentration and cloud height.
- Exit velocity: Maximum concentration and cloud height very sensitive to exit velocity.
- Source temperature: Not a significant factor for maximum concentration and cloud height.
- Receptor height: Not a significant factor for scenarios evaluated.

Table F-2.3-1. SCREEN (nonflare) sensitivity analysis - OD

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Emission rate (g/s)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Stack height	0.0	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stack inside diameter (m)	10	10	2	10	20	10	10	10	10	10	10	10	10	10	10	10	10	10
Stack exit velocity (m/s)	3	3	3	3	3	0.01	0.1	1.0	3.0	10.0	20.0	3	3	3	3	3	3	3
Stack exit temperature (K)	800	800	800	800	800	800	800	800	800	800	800	400	800	1,000	1,500	2,000	800	800
Ambient air temperature	293	293	293	293	293	293	293	293	293	293	293	293	293	293	293	293	293	293
Receptor height (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
Maximum 1-hr concentration ($\mu g/m^3$)[a]	0.8737	1.004	71.95	0.8737	0.2838	743.5	95.25	3.753	0.8737	0.3379	0.1728	2.798	0.8737	0.7468	0.6252	0.5904	0.8737	0.8745
Distance to maximum concentration (m)[a]	1,477	1,390	146	1,477	1,449	100	125	747	1,477	1,375	1,679	881	1,477	1,633	1,257	1,278	1,477	1,473
Plume height at maximum concentration (m)[a]	77.2	69.6	9.6	77.2	1183.1	6.0	8.4	40.0	77.2	1060.5	1607.4	46.0	77.2	82.5	891.4	923.5	77.2	77.2

[a]Full meterology.

ATTACHMENT F-2-A

POLU MODELING RUNS (OD)

MATERIAL=C-4 - OD

DETONATION BURN---MATERIAL DETONATES BEFORE REACTING WITH AIR---

H C N O

RDX -(S)	0.0060.0030.0060.0060.0000.0000.0000.0000.0000.0000.0000.000	90.000	72.	0.0656
POL-ISOBUTLENE(L-14)	0.0140.0070.0000.0000.0000.0000.0000.0000.0000.0000.0000.000	10.000	-354.	0.0302
AIR -(G	0.0000.0000.0060.0010.0000.0000.0000.0000.0000.0000.0000.000	0.000	0.	0.0000

0GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

0 (H) (C) (N) (O) (

3.858799 1.928256 2.431020 2.431020

WT. MATERIAL	100.000	90.000	80.000	70.000	60.000	50.000	40.000	30.000	20.000	10.000
WT.--LAST INGREDIENT	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000
OXID/MATERIAL RATIO	0.0000	0.1111	0.2500	0.4286	0.6667	1.0000	1.5000	2.3333	4.0000	9.0000

---COMBUSTION CONDITIONS: AIR IS MIXED WITH THE MATERIAL'S COMBUSTION PRODUCTS AFTER---
---THE MATERIAL HAS EXPLODED. (WT. MATERIAL/WT. AIR IS SHOWN ABOVE)---
--CAUTION: DATA BELOW FLAME TEMP. OF 300 K QUESTIONABLE.

FLAME TEMP. T(K)	1221.799	1244.285	1293.192	1409.300	1599.813	1813.145	2046.652	2299.768	1845.893	1152.683
FLAME TEMP. T(F)	1739.838	1780.313	1868.346	2077.339	2420.263	2804.260	3224.574	3680.182	2863.207	1615.430
ENTHALPY KCAL/GFW	-61.069	-54.962	-48.855	-42.749	-36.642	-30.535	-24.428	-18.321	-12.214	-6.107

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS BELOW ARE FROM THE MATERIAL/AIR---
---MIXTURES ABOVE AFTER EXPANDING FROM 1000.00 PSI TO 14.7000 PSI---

FLAME TEMP. T(K)	843.423	845.879	847.991	848.689	845.742	837.478	862.433	965.780	718.369	393.475
FLAME TEMP. T(F)	1058.762	1063.182	1066.984	1068.240	1062.936	1048.061	1092.979	1279.003	833.664	248.855
ENTHALPY KCAL/GFW	-97.707	-91.626	-85.670	-80.021	-74.997	-70.708	-67.100	-63.821	-47.356	-26.920
T.VOL.GASES--LITERS	106.612	114.169	123.497	135.314	150.812	172.249	208.106	261.205	388.152	778.092
(GASES AT STP)										
TOTAL HEAT RELEASED*	631.940	689.397	762.462	860.421	1000.367	1208.328	1593.583	2338.086	2521.872	2521.376

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-03

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

N2	34.046	42.807	53.758	67.838	86.612	112.895	152.322	218.035	349.451	743.699
CO2	31.852	34.225	37.198	41.125	46.706	55.087	64.778	80.303	84.849	84.834
H2O	11.731	11.671	11.625	11.667	11.940	12.568	18.448	31.754	34.756	34.751
CO	9.309	10.497	11.926	13.474	14.759	15.458	12.493	2.897	0.000	0.000
C$	8.543	7.531	6.256	4.664	2.713	0.229	0.000	0.000	0.000	0.000
CH4	2.580	2.387	2.188	1.996	1.830	1.693	0.164	0.000	0.000	0.000
H2	1.927	1.982	2.037	2.081	2.092	2.056	1.783	0.336	0.000	0.000
NH3	0.009	0.009	0.009	0.009	0.009	0.010	0.006	0.000	0.000	0.000
N2O5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	30.931	136.691

*THE TOTAL HEAT RELEASED, IN CAL/GR AT STP, IN EACH COLUMN IS FOR 100 GRAMS
OF MATERIAL BURNED OR DETONATED, NOT THE MATERIAL WT. LISTED IN "WT. MATERIAL" ROW.
USE THESE VALUES IN DISPERSION MODELS.

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

N2	CO2	H2O	CO	C$	CH4	H2	NH3	N2O5	N2O4	N2O4$	N2O4*	C4N2	N2O3	C3O2
NHO3	NO3	C5	C4H10	C4H8	C2N2	C4	O3	NHO2	NO2	C3H8	C2H4O	N2O	CNHO	C3H6
N3	CNO	CN2	CN2	C2O	C2N	C3	H2O2	HO2	C2H6	N2H4	N2H4*	O2	NHO	N2H2
CH2O	NO	NO	CHO	CHO	C2H4	CNH	C2H2	CN	CN	C2H	C2	H3O	H2O*	H2O*
HO	HO	NH2	O	CH3	NH	CH2	N	CH	C	C$	H	H		

MATERIAL=TNT 100% - OD

DETONATION BURN---MATERIAL DETONATES BEFORE REACTING WITH AIR---

```
                                   H    C    N    O

TRINITROTOLUENE            0.0050.0070.0030.0060.0000.0000.0000.0000.0000.0000.0000.000  100.000      -78.   0.0597
AIR          -(G           0.0000.0000.0060.0010.0000.0000.0000.0000.0000.0000.0000.000    0.000        0.   0.0000
OGRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF  100.000                                                     1.0000
0   (H )     (C )      (N )      (O )      (
 2.201276  3.081786  1.320765  2.641531
```

WT. MATERIAL	100.000	90.000	80.000	70.000	60.000	50.000	40.000	30.000	20.000	10.000
WT.--LAST INGREDIENT	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000
OXID/MATERIAL RATIO	0.0000	0.1111	0.2500	0.4286	0.6667	1.0000	1.5000	2.3333	4.0000	9.0000

---COMBUSTION CONDITIONS: AIR IS MIXED WITH THE MATERIAL'S COMBUSTION PRODUCTS AFTER---
---THE MATERIAL HAS EXPLODED. (WT. MATERIAL/WT. AIR IS SHOWN ABOVE)---
--CAUTION: DATA BELOW FLAME TEMP. OF 300 K QUESTIONABLE.

FLAME TEMP. T(K)	1288.163	1295.039	1303.568	1314.314	1336.966	1582.915	1880.740	2196.628	2250.401	1378.160
FLAME TEMP. T(F)	1859.294	1871.671	1887.023	1906.365	1947.139	2389.847	2925.932	3494.530	3591.322	2021.288
ENTHALPY KCAL/GFW	-57.838	-52.054	-46.271	-40.487	-34.703	-28.919	-23.135	-17.351	-11.568	-5.784

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS BELOW ARE FROM THE MATERIAL/AIR---
---MIXTURES ABOVE AFTER EXPANDING FROM 1000.00 PSI TO 14.7000 PSI---

FLAME TEMP. T(K)	920.428	917.951	915.412	912.793	910.064	903.413	887.420	913.528	939.567	492.698
FLAME TEMP. T(F)	1197.370	1192.912	1188.342	1183.628	1178.716	1166.743	1137.956	1184.951	1231.820	427.456
ENTHALPY KCAL/GFW	-89.979	-84.685	-79.397	-74.118	-68.853	-64.317	-61.241	-59.494	-53.504	-30.522
T.VOL.GASES--LITERS (GASES AT STP)	106.927	114.063	122.960	134.373	149.554	170.730	202.389	255.977	368.758	758.698
TOTAL HEAT RELEASED*	560.352	617.872	690.065	783.046	907.292	1094.356	1406.030	2028.885	3072.341	3071.864

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-03

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

CO2	32.746	34.830	37.443	40.798	45.273	52.524	65.920	92.345	135.617	135.602
CO	23.813	25.295	27.130	29.488	32.623	35.517	36.181	27.511	0.000	0.000
N2	18.498	27.259	38.210	52.291	71.064	97.347	136.772	202.482	333.898	728.147
C$	17.401	16.228	14.762	12.871	10.344	7.157	3.238	0.000	0.000	0.000
H2O	5.464	5.450	5.438	5.427	5.417	5.557	6.069	9.856	19.825	19.820
H2	1.451	1.463	1.475	1.489	1.503	1.498	1.448	1.111	0.000	0.000
CH4	0.622	0.580	0.535	0.487	0.435	0.390	0.361	0.019	0.000	0.000
NH3	0.003	0.003	0.003	0.003	0.003	0.003	0.004	0.002	0.000	0.000
N2O5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
O2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.645	116.406
NO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000

*THE TOTAL HEAT RELEASED, IN CAL/GR AT STP, IN EACH COLUMN IS FOR 100 GRAMS
OF MATERIAL BURNED OR DETONATED, NOT THE MATERIAL WT. LISTED IN "WT. MATERIAL" ROW.
USE THESE VALUES IN DISPERSION MODELS.

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

CO2	CO	N2	C$	H2O	H2	CH4	NH3	N2O5	N2O4	N2O4$	N2O4*	C4N2	N2O3	C3O2
NHO3	NO3	C5	C4H10	C4H8	C2N2	C4	O3	NHO2	NO2	CNH	C3H8	C2H4O	N2O	CNHO
C3H6	N3	CNO	CN2	CN2	C2O	C2N	C3	H2O2	HO2	N2H4	N2H4*	O2	NHO	C2H6
N2H2	CH2O	NO	NO	CHO	CHO	C2H4	C2H2	CN	CN	C2H	C2	H3O	H2O*	H2O*
HO	HO	NH2	O	CH3	NH	CH2	N	CH	C	C$	H	H		

ATTACHMENT F-2-B

OD SCREEN MODELING RUNS

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 1

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE            =    POINT
   EMISSION RATE (G/S)    =    1.000
   STACK HEIGHT (M)       =      .00
   STK INSIDE DIAM (M)    =    10.00
   STK EXIT VELOCITY (M/S)=     3.00
   STK GAS EXIT TEMP (K)  =   800.00
   AMBIENT AIR TEMP (K)   =   293.00
   RECEPTOR HEIGHT (M)    =      .00
   IOPT (1=URB,2=RUR)     =     2
   BUILDING HEIGHT (M)    =      .00
   MIN HORIZ BLDG DIM (M) =      .00
   MAX HORIZ BLDG DIM (M) =      .00
```

BUOY. FLUX = 466.09 M**4/S**3; MOM. FLUX = 82.41 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.2350	6	1.0	1.0	5000.0	191.2	54.8	54.7	NO
200.	.2383	6	1.0	1.0	5000.0	191.2	55.2	54.8	NO
300.	.2423	6	1.0	1.0	5000.0	191.2	55.8	54.9	NO
400.	.2470	6	1.0	1.0	5000.0	191.2	56.6	55.1	NO
500.	.2522	6	1.0	1.0	5000.0	191.2	57.5	55.3	NO
600.	.2580	6	1.0	1.0	5000.0	191.2	58.6	55.5	NO
700.	.2642	6	1.0	1.0	5000.0	191.2	59.9	55.7	NO
800.	.4086	1	3.0	3.0	960.0	515.0	199.4	300.8	NO
900.	.5385	4	20.0	20.0	5000.0	77.2	64.1	33.8	NO
1000.	.6768	1	2.0	2.0	773.5	772.5	273.8	487.2	NO
1100.	.7711	1	2.0	2.0	773.5	772.5	295.3	586.5	NO
1200.	.8070	4	20.0	20.0	5000.0	77.2	82.9	41.3	NO
1300.	.8478	4	20.0	20.0	5000.0	77.2	89.1	43.5	NO
1400.	.8722	4	20.0	20.0	5000.0	77.2	95.1	45.6	NO
1500.	.8736	4	20.0	20.0	5000.0	77.2	101.0	47.2	NO
1600.	.8704	4	20.0	20.0	5000.0	77.2	106.8	48.7	NO
1700.	.8636	4	20.0	20.0	5000.0	77.2	112.6	50.3	NO
1800.	.8538	4	20.0	20.0	5000.0	77.2	118.4	51.8	NO
1900.	.8419	4	20.0	20.0	5000.0	77.2	124.1	53.3	NO
2000.	.8282	4	20.0	20.0	5000.0	77.2	129.8	54.8	NO
2100.	.8132	4	20.0	20.0	5000.0	77.2	135.5	56.3	NO
2200.	.7973	4	20.0	20.0	5000.0	77.2	141.2	57.7	NO
2300.	.7808	4	20.0	20.0	5000.0	77.2	146.9	59.1	NO
2400.	.7639	4	20.0	20.0	5000.0	77.2	152.5	60.6	NO
2500.	.7468	4	20.0	20.0	5000.0	77.2	158.1	62.0	NO
2600.	.7296	4	20.0	20.0	5000.0	77.2	163.7	63.4	NO
2700.	.7124	4	20.0	20.0	5000.0	77.2	169.3	64.7	NO
2800.	.6955	4	20.0	20.0	5000.0	77.2	174.9	66.1	NO
2900.	.6787	4	20.0	20.0	5000.0	77.2	180.4	67.4	NO

3500.	.5852	4	20.0	20.0	5000.0	77.2	213.3	74.8	NO
4000.	.5574	5	5.0	5.0	5000.0	134.8	183.2	62.9	NO
4500.	.5734	5	5.0	5.0	5000.0	134.8	202.8	65.4	NO
5000.	.5840	5	5.0	5.0	5000.0	134.8	222.2	67.7	NO
5500.	.5901	5	5.0	5.0	5000.0	134.8	241.5	70.0	NO
6000.	.5974	5	4.0	4.0	5000.0	145.2	261.1	73.8	NO
6500.	.6018	5	4.0	4.0	5000.0	145.2	280.0	75.9	NO
7000.	.6089	5	3.0	3.0	5000.0	159.8	299.4	80.3	NO
7500.	.6138	5	3.0	3.0	5000.0	159.8	318.1	82.2	NO
8000.	.6168	5	3.0	3.0	5000.0	159.8	336.6	84.1	NO
8500.	.6223	5	2.0	2.0	5000.0	182.9	355.9	89.6	NO
9000.	.6282	5	2.0	2.0	5000.0	182.9	374.1	91.4	NO
9500.	.6327	5	2.0	2.0	5000.0	182.9	392.2	93.1	NO
10000.	.6358	5	2.0	2.0	5000.0	182.9	410.3	94.8	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1477.	.8737	4	20.0	20.0	5000.0	77.2	99.6	46.8	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE      *
*********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.8737	1477.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 2

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE             =    POINT
   EMISSION RATE (G/S)     =    1.000
   STACK HEIGHT (M)        =    20.00
   STK INSIDE DIAM (M)     =    10.00
   STK EXIT VELOCITY (M/S)=      3.00
   STK GAS EXIT TEMP (K)   =   800.00
   AMBIENT AIR TEMP (K)    =   293.00
   RECEPTOR HEIGHT (M)     =      .00
   IOPT (1=URB,2=RUR)      =     2
   BUILDING HEIGHT (M)     =      .00
   MIN HORIZ BLDG DIM (M)  =      .00
   MAX HORIZ BLDG DIM (M)  =      .00
```

BUOY. FLUX = 466.09 M**4/S**3; MOM. FLUX = 82.41 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.4457E-01	6	1.0	1.5	5000.0	188.4	48.3	48.2	NO
200.	.6343E-01	6	2.0	2.9	5000.0	144.2	39.0	38.4	NO
300.	.1079	6	3.0	4.4	5000.0	120.4	35.2	33.8	NO
400.	.1513	6	4.0	5.9	5000.0	106.3	33.7	31.1	NO
500.	.1617	6	4.0	5.9	5000.0	106.3	35.2	31.5	NO
600.	.2052	4	20.0	22.2	5000.0	69.6	44.2	24.1	NO
700.	.3873	4	20.0	22.2	5000.0	69.6	50.8	27.1	NO
800.	.5747	4	20.0	22.2	5000.0	69.6	57.3	30.1	NO
900.	.7388	4	20.0	22.2	5000.0	69.6	63.6	33.0	NO
1000.	.8675	4	20.0	22.2	5000.0	69.6	70.0	35.8	NO
1100.	.9321	4	20.0	22.2	5000.0	69.6	76.2	38.1	NO
1200.	.9733	4	20.0	22.2	5000.0	69.6	82.4	40.3	NO
1300.	.9959	4	20.0	22.2	5000.0	69.6	88.6	42.5	NO
1400.	1.003	4	20.0	22.2	5000.0	69.6	94.7	44.5	NO
1500.	.9916	4	20.0	22.2	5000.0	69.6	100.5	46.2	NO
1600.	.9762	4	20.0	22.2	5000.0	69.6	106.4	47.8	NO
1700.	.9579	4	20.0	22.2	5000.0	69.6	112.2	49.4	NO
1800.	.9376	4	20.0	22.2	5000.0	69.6	118.0	50.9	NO
1900.	.9158	4	20.0	22.2	5000.0	69.6	123.7	52.4	NO
2000.	.8931	4	20.0	22.2	5000.0	69.6	129.5	54.0	NO
2100.	.8699	4	20.0	22.2	5000.0	69.6	135.2	55.4	NO
2200.	.8465	4	20.0	22.2	5000.0	69.6	140.9	56.9	NO
2300.	.8233	4	20.0	22.2	5000.0	69.6	146.6	58.4	NO
2400.	.8002	4	20.0	22.2	5000.0	69.6	152.2	59.8	NO
2500.	.7776	4	20.0	22.2	5000.0	69.6	157.8	61.2	NO
2600.	.7554	4	20.0	22.2	5000.0	69.6	163.5	62.6	NO
2700.	.7337	4	20.0	22.2	5000.0	69.6	169.0	64.0	NO
2800.	.7127	4	20.0	22.2	5000.0	69.6	174.6	65.4	NO
2900.	.6923	4	20.0	22.2	5000.0	69.6	180.2	66.7	NO

3500.	.5841	4	20.0	22.2	5000.0	69.6	213.1	74.2	NO
4000.	.5666	5	5.0	6.4	5000.0	124.3	182.5	61.1	NO
4500.	.5764	5	5.0	6.4	5000.0	124.3	202.2	63.6	NO
5000.	.5808	5	5.0	6.4	5000.0	124.3	221.7	66.1	NO
5500.	.5811	5	5.0	6.4	5000.0	124.3	241.0	68.4	NO
6000.	.5782	5	5.0	6.4	5000.0	124.3	260.2	70.7	NO
6500.	.5728	5	5.0	6.4	5000.0	124.3	279.2	72.8	NO
7000.	.5758	6	4.0	5.9	5000.0	106.3	199.3	50.2	NO
7500.	.5771	6	4.0	5.9	5000.0	106.3	211.7	51.1	NO
8000.	.5773	6	4.0	5.9	5000.0	106.3	224.0	52.0	NO
8500.	.5767	6	4.0	5.9	5000.0	106.3	236.3	52.9	NO
9000.	.5753	6	4.0	5.9	5000.0	106.3	248.5	53.8	NO
9500.	.5732	6	4.0	5.9	5000.0	106.3	260.6	54.6	NO
10000.	.5706	6	4.0	5.9	5000.0	106.3	272.6	55.4	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1390.	1.004	4	20.0	22.2	5000.0	69.6	94.0	44.4	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
* SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *
* SIMPLE ELEVATED TERRAIN PROCEDURE *
****

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	1.004	1390.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 3

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 1.000
STACK HEIGHT (M) = .00
STK INSIDE DIAM (M) = 2.00
STK EXIT VELOCITY (M/S)= 3.00
STK GAS EXIT TEMP (K) = 800.00
AMBIENT AIR TEMP (K) = 293.00
RECEPTOR HEIGHT (M) = .00
IOPT (1=URB,2=RUR) = 2
BUILDING HEIGHT (M) = .00
MIN HORIZ BLDG DIM (M) = .00
MAX HORIZ BLDG DIM (M) = .00

BUOY. FLUX = 18.64 M**4/S**3; MOM. FLUX = 3.30 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	54.82	4	20.0	20.0	5000.0	9.6	8.3	4.8	NO
200.	63.37	4	20.0	20.0	5000.0	9.6	15.7	8.7	NO
300.	43.85	4	15.0	15.0	4800.0	12.8	22.9	12.6	NO
400.	32.63	4	15.0	15.0	4800.0	12.8	29.7	15.7	NO
500.	27.47	4	10.0	10.0	3200.0	19.2	36.6	19.1	NO
600.	23.08	4	8.0	8.0	2560.0	24.0	43.3	22.3	NO
700.	20.19	4	8.0	8.0	2560.0	24.0	49.7	25.0	NO
800.	17.62	4	8.0	8.0	2560.0	24.0	56.0	27.6	NO
900.	15.41	4	8.0	8.0	2560.0	24.0	62.3	30.3	NO
1000.	14.31	4	5.0	5.0	1600.0	38.4	69.0	33.9	NO
1100.	13.30	4	5.0	5.0	1600.0	38.4	75.1	35.8	NO
1200.	12.37	4	5.0	5.0	1600.0	38.4	81.2	37.7	NO
1300.	11.51	4	5.0	5.0	1600.0	38.4	87.2	39.6	NO
1400.	11.47	6	4.0	4.0	5000.0	41.2	47.5	20.9	NO
1500.	11.75	6	4.0	4.0	5000.0	41.2	50.4	21.5	NO
1600.	12.04	6	3.0	3.0	5000.0	45.3	53.6	22.8	NO
1700.	12.32	6	3.0	3.0	5000.0	45.3	56.4	23.4	NO
1800.	12.54	6	3.0	3.0	5000.0	45.3	59.3	24.0	NO
1900.	12.81	6	2.0	2.0	5000.0	51.9	62.6	25.7	NO
2000.	13.09	6	2.0	2.0	5000.0	51.9	65.4	26.2	NO
2100.	13.22	6	2.0	2.0	5000.0	51.9	68.2	26.7	NO
2200.	13.32	6	2.0	2.0	5000.0	51.9	71.0	27.2	NO
2300.	13.40	6	2.0	2.0	5000.0	51.9	73.8	27.7	NO
2400.	13.45	6	2.0	2.0	5000.0	51.9	76.6	28.1	NO
2500.	13.48	6	2.0	2.0	5000.0	51.9	79.3	28.6	NO
2600.	13.64	6	1.0	1.0	5000.0	65.4	82.9	31.2	NO
2700.	13.80	6	1.0	1.0	5000.0	65.4	85.6	31.6	NO
2800.	13.95	6	1.0	1.0	5000.0	65.4	88.4	32.0	NO
2900.	14.08	6	1.0	1.0	5000.0	65.4	91.1	32.4	NO

3500.	14.24	6	1.0	1.0	5000.0	65.4	107.3	34.5	NO
4000.	14.13	6	1.0	1.0	5000.0	65.4	120.6	36.1	NO
4500.	13.90	6	1.0	1.0	5000.0	65.4	133.8	37.6	NO
5000.	13.61	6	1.0	1.0	5000.0	65.4	146.9	39.0	NO
5500.	13.27	6	1.0	1.0	5000.0	65.4	159.8	40.3	NO
6000.	12.91	6	1.0	1.0	5000.0	65.4	172.6	41.7	NO
6500.	12.54	6	1.0	1.0	5000.0	65.4	185.3	42.9	NO
7000.	12.16	6	1.0	1.0	5000.0	65.4	197.9	44.2	NO
7500.	11.75	6	1.0	1.0	5000.0	65.4	210.4	45.2	NO
8000.	11.36	6	1.0	1.0	5000.0	65.4	222.8	46.2	NO
8500.	10.99	6	1.0	1.0	5000.0	65.4	235.1	47.2	NO
9000.	10.63	6	1.0	1.0	5000.0	65.4	247.3	48.2	NO
9500.	10.29	6	1.0	1.0	5000.0	65.4	259.5	49.1	NO
10000.	9.967	6	1.0	1.0	5000.0	65.4	271.5	50.0	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

146.	71.95	4	20.0	20.0	5000.0	9.6	11.8	6.7	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	71.95	146.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 4

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	10.00
STK EXIT VELOCITY (M/S)	=	3.00
STK GAS EXIT TEMP (K)	=	800.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 466.09 M**4/S**3; MOM. FLUX = 82.41 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.2350	6	1.0	1.0	5000.0	191.2	54.8	54.7	NO
200.	.2383	6	1.0	1.0	5000.0	191.2	55.2	54.8	NO
300.	.2423	6	1.0	1.0	5000.0	191.2	55.8	54.9	NO
400.	.2470	6	1.0	1.0	5000.0	191.2	56.6	55.1	NO
500.	.2522	6	1.0	1.0	5000.0	191.2	57.5	55.3	NO
600.	.2580	6	1.0	1.0	5000.0	191.2	58.6	55.5	NO
700.	.2642	6	1.0	1.0	5000.0	191.2	59.9	55.7	NO
800.	.4086	1	3.0	3.0	960.0	515.0	199.4	300.8	NO
900.	.5385	4	20.0	20.0	5000.0	77.2	64.1	33.8	NO
1000.	.6768	1	2.0	2.0	773.5	772.5	273.8	487.2	NO
1100.	.7711	1	2.0	2.0	773.5	772.5	295.3	586.5	NO
1200.	.8070	4	20.0	20.0	5000.0	77.2	82.9	41.3	NO
1300.	.8478	4	20.0	20.0	5000.0	77.2	89.1	43.5	NO
1400.	.8722	4	20.0	20.0	5000.0	77.2	95.1	45.6	NO
1500.	.8736	4	20.0	20.0	5000.0	77.2	101.0	47.2	NO
1600.	.8704	4	20.0	20.0	5000.0	77.2	106.8	48.7	NO
1700.	.8636	4	20.0	20.0	5000.0	77.2	112.6	50.3	NO
1800.	.8538	4	20.0	20.0	5000.0	77.2	118.4	51.8	NO
1900.	.8419	4	20.0	20.0	5000.0	77.2	124.1	53.3	NO
2000.	.8282	4	20.0	20.0	5000.0	77.2	129.8	54.8	NO
2100.	.8132	4	20.0	20.0	5000.0	77.2	135.5	56.3	NO
2200.	.7973	4	20.0	20.0	5000.0	77.2	141.2	57.7	NO
2300.	.7808	4	20.0	20.0	5000.0	77.2	146.9	59.1	NO
2400.	.7639	4	20.0	20.0	5000.0	77.2	152.5	60.6	NO
2500.	.7468	4	20.0	20.0	5000.0	77.2	158.1	62.0	NO
2600.	.7296	4	20.0	20.0	5000.0	77.2	163.7	63.4	NO
2700.	.7124	4	20.0	20.0	5000.0	77.2	169.3	64.7	NO
2800.	.6955	4	20.0	20.0	5000.0	77.2	174.9	66.1	NO
2900.	.6787	4	20.0	20.0	5000.0	77.2	180.4	67.4	NO

3500.	.5852	4	20.0	20.0	5000.0	77.2	213.3	74.6	NO
4000.	.5574	5	5.0	5.0	5000.0	134.8	183.2	62.9	NO
4500.	.5734	5	5.0	5.0	5000.0	134.8	202.8	65.4	NO
5000.	.5840	5	5.0	5.0	5000.0	134.8	222.2	67.7	NO
5500.	.5901	5	5.0	5.0	5000.0	134.8	241.5	70.0	NO
6000.	.5974	5	4.0	4.0	5000.0	145.2	261.1	73.8	NO
6500.	.6018	5	4.0	4.0	5000.0	145.2	280.0	75.9	NO
7000.	.6089	5	3.0	3.0	5000.0	159.8	299.4	80.3	NO
7500.	.6138	5	3.0	3.0	5000.0	159.8	318.1	82.2	NO
8000.	.6168	5	3.0	3.0	5000.0	159.8	336.6	84.1	NO
8500.	.6223	5	2.0	2.0	5000.0	182.9	355.9	89.6	NO
9000.	.6282	5	2.0	2.0	5000.0	182.9	374.1	91.4	NO
9500.	.6327	5	2.0	2.0	5000.0	182.9	392.2	93.1	NO
10000.	.6358	5	2.0	2.0	5000.0	182.9	410.3	94.8	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1477.	.8737	4	20.0	20.0	5000.0	77.2	99.6	46.8	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
*********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.8737	1477.	0.

```
****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 5

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE             =   POINT
   EMISSION RATE (G/S)     =   1.000
   STACK HEIGHT (M)        =     .00
   STK INSIDE DIAM (M)     =   20.00
   STK EXIT VELOCITY (M/S)=     3.00
   STK GAS EXIT TEMP (K)   =  800.00
   AMBIENT AIR TEMP (K)    =  293.00
   RECEPTOR HEIGHT (M)     =     .00
   IOPT (1=URB,2=RUR)      =    2
   BUILDING HEIGHT (M)     =     .00
   MIN HORIZ BLDG DIM (M) =      .00
   MAX HORIZ BLDG DIM (M) =      .00
```

BUOY. FLUX = 1864.37 M**4/S**3; MOM. FLUX = 329.63 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.9283E-01	6	1.0	1.0	5000.0	303.6	86.8	86.8	NO
200.	.9336E-01	6	1.0	1.0	5000.0	303.6	87.1	86.8	NO
300.	.9398E-01	6	1.0	1.0	5000.0	303.6	87.5	86.9	NO
400.	.9470E-01	6	1.0	1.0	5000.0	303.6	88.0	87.0	NO
500.	.9549E-01	6	1.0	1.0	5000.0	303.6	88.6	87.1	NO
600.	.9635E-01	6	1.0	1.0	5000.0	303.6	89.3	87.3	NO
700.	.9727E-01	6	1.0	1.0	5000.0	303.6	90.1	87.4	NO
800.	.9797E-01	6	1.0	1.0	5000.0	303.6	91.0	87.6	NO
900.	.9866E-01	6	1.0	1.0	5000.0	303.6	92.0	87.7	NO
1000.	.9934E-01	6	1.0	1.0	5000.0	303.6	93.1	87.8	NO
1100.	.1589	1	3.0	3.0	1184.1	1183.1	302.4	590.2	NO
1200.	.2241	1	3.0	3.0	1184.1	1183.1	323.9	700.4	NO
1300.	.2651	1	3.0	3.0	1184.1	1183.1	345.0	821.8	NO
1400.	.2821	1	3.0	3.0	1184.1	1183.1	365.8	954.4	NO
1500.	.2823	1	3.0	3.0	1184.1	1183.1	386.4	1098.4	NO
1600.	.2740	1	3.0	3.0	1184.1	1183.1	406.7	1253.8	NO
1700.	.2628	1	3.0	3.0	1184.1	1183.1	426.7	1420.7	NO
1800.	.2514	1	3.0	3.0	1184.1	1183.1	446.5	1599.1	NO
1900.	.2409	1	3.0	3.0	1184.1	1183.1	466.2	1789.0	NO
2000.	.2313	1	3.0	3.0	1184.1	1183.1	485.6	1990.6	NO
2100.	.2225	1	3.0	3.0	1184.1	1183.1	504.8	2203.9	NO
2200.	.2144	1	3.0	3.0	1184.1	1183.1	523.9	2429.0	NO
2300.	.2069	1	3.0	3.0	1184.1	1183.1	542.8	2665.8	NO
2400.	.2000	1	3.0	3.0	1184.1	1183.1	561.6	2914.6	NO
2500.	.1950	1	3.0	3.0	1184.1	1183.1	575.8	3174.4	NO
2600.	.1907	1	3.0	3.0	1184.1	1183.1	589.0	3446.2	NO
2700.	.1865	1	3.0	3.0	1184.1	1183.1	602.3	3730.2	NO
2800.	.1824	1	3.0	3.0	1184.1	1183.1	615.6	4026.3	NO
2900.	.1785	1	3.0	3.0	1184.1	1183.1	628.0	4334.6	NO

3500.	.1581	1	3.0	3.0	1184.1	1183.1	710.3	5000.0	NO
4000.	.1443	1	3.0	3.0	1184.1	1183.1	778.5	5000.0	NO
4500.	.1326	1	3.0	3.0	1184.1	1183.1	846.9	5000.0	NO
5000.	.1227	1	3.0	3.0	1184.1	1183.1	915.3	5000.0	NO
5500.	.1248	5	5.0	5.0	5000.0	213.9	246.1	84.6	NO
6000.	.1298	5	5.0	5.0	5000.0	213.9	264.9	86.4	NO
6500.	.1344	5	5.0	5.0	5000.0	213.9	283.6	88.2	NO
7000.	.1387	5	5.0	5.0	5000.0	213.9	302.2	90.0	NO
7500.	.1425	5	5.0	5.0	5000.0	213.9	320.7	91.7	NO
8000.	.1460	5	5.0	5.0	5000.0	213.9	339.0	93.4	NO
8500.	.1491	5	5.0	5.0	5000.0	213.9	357.3	95.1	NO
9000.	.1519	5	5.0	5.0	5000.0	213.9	375.5	96.7	NO
9500.	.1544	5	5.0	5.0	5000.0	213.9	393.5	98.3	NO
10000.	.1566	5	5.0	5.0	5000.0	213.9	411.5	99.9	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1449.	.2838	1	3.0	3.0	1184.1	1183.1	375.7	1022.1	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.2838	1449.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

10-07-94
14:40:38

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 6

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE             =    POINT
   EMISSION RATE (G/S)     =    1.000
   STACK HEIGHT (M)        =      .00
   STK INSIDE DIAM (M)     =    10.00
   STK EXIT VELOCITY (M/S)=       .01
   STK GAS EXIT TEMP (K)   =   800.00
   AMBIENT AIR TEMP (K)    =   293.00
   RECEPTOR HEIGHT (M)     =      .00
   IOPT (1=URB,2=RUR)      =     2
   BUILDING HEIGHT (M)     =      .00
   MIN HORIZ BLDG DIM (M) =       .00
   MAX HORIZ BLDG DIM (M) =       .00
```

BUOY. FLUX =   1.55 M**4/S**3; MOM. FLUX =   .00 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF   0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	743.5	4	5.0	5.0	1600.0	6.0	8.4	5.0	NO
200.	404.6	4	3.0	3.0	960.0	9.9	15.8	9.0	NO
300.	274.4	4	2.0	2.0	640.0	14.9	23.0	12.8	NO
400.	216.8	4	2.0	2.0	640.0	14.9	29.8	15.9	NO
500.	169.9	4	2.0	2.0	640.0	14.9	36.4	18.8	NO
600.	136.6	4	1.0	1.0	320.0	29.8	43.6	22.9	NO
700.	126.2	4	1.0	1.0	320.0	29.8	49.9	25.5	NO
800.	114.8	4	1.0	1.0	320.0	29.8	56.2	28.1	NO
900.	115.0	6	1.0	1.0	5000.0	28.6	31.8	15.3	NO
1000.	118.5	6	1.0	1.0	5000.0	28.6	34.9	16.2	NO
1100.	119.5	6	1.0	1.0	5000.0	28.6	37.9	16.9	NO
1200.	119.3	6	1.0	1.0	5000.0	28.6	40.8	17.7	NO
1300.	118.2	6	1.0	1.0	5000.0	28.6	43.8	18.4	NO
1400.	116.4	6	1.0	1.0	5000.0	28.6	46.8	19.1	NO
1500.	114.2	6	1.0	1.0	5000.0	28.6	49.7	19.8	NO
1600.	111.6	6	1.0	1.0	5000.0	28.6	52.6	20.5	NO
1700.	108.9	6	1.0	1.0	5000.0	28.6	55.5	21.2	NO
1800.	105.9	6	1.0	1.0	5000.0	28.6	58.4	21.8	NO
1900.	103.0	6	1.0	1.0	5000.0	28.6	61.3	22.5	NO
2000.	99.96	6	1.0	1.0	5000.0	28.6	64.2	23.1	NO
2100.	96.80	6	1.0	1.0	5000.0	28.6	67.1	23.7	NO
2200.	93.75	6	1.0	1.0	5000.0	28.6	69.9	24.2	NO
2300.	90.80	6	1.0	1.0	5000.0	28.6	72.7	24.7	NO
2400.	87.97	6	1.0	1.0	5000.0	28.6	75.6	25.2	NO
2500.	85.24	6	1.0	1.0	5000.0	28.6	78.4	25.8	NO
2600.	82.63	6	1.0	1.0	5000.0	28.6	81.2	26.3	NO
2700.	80.12	6	1.0	1.0	5000.0	28.6	84.0	26.7	NO
2800.	77.72	6	1.0	1.0	5000.0	28.6	86.7	27.2	NO
2900.	75.42	6	1.0	1.0	5000.0	28.6	89.5	27.7	NO

```
 3500.   63.81          6      1.0      1.0  5000.0     28.6    106.0      30.1     NO
 4000.   55.94          6      1.0      1.0  5000.0     28.6    119.4      31.9     NO
 4500.   49.73          6      1.0      1.0  5000.0     28.6    132.8      33.6     NO
 5000.   44.60          6      1.0      1.0  5000.0     28.6    145.9      35.2     NO
 5500.   40.33          6      1.0      1.0  5000.0     28.6    158.9      36.7     NO
 6000.   36.71          6      1.0      1.0  5000.0     28.6    171.8      38.1     NO
 6500.   33.62          6      1.0      1.0  5000.0     28.6    184.5      39.5     NO
 7000.   30.96          6      1.0      1.0  5000.0     28.6    197.2      40.8     NO
 7500.   28.69          6      1.0      1.0  5000.0     28.6    209.7      42.0     NO
 8000.   26.70          6      1.0      1.0  5000.0     28.6    222.1      43.1     NO
 8500.   24.95          6      1.0      1.0  5000.0     28.6    234.5      44.1     NO
 9000.   23.39          6      1.0      1.0  5000.0     28.6    246.7      45.1     NO
 9500.   22.00          6      1.0      1.0  5000.0     28.6    258.9      46.1     NO
10000.   20.75          6      1.0      1.0  5000.0     28.6    271.0      47.1     NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
  100.   743.5          4      5.0      5.0  1600.0      6.0      8.4       5.0     NO

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

 ********************************************
 *  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
 *    SIMPLE ELEVATED TERRAIN PROCEDURE     *
 ********************************************

      TERRAIN       DISTANCE RANGE (M)
       HT (M)      MINIMUM    MAXIMUM
      -------     --------   --------
           0.         100.     10000.

     ***************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ***************************************

 CALCULATION        MAX CONC    DIST TO   TERRAIN
  PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
--------------    -----------   -------   -------
SIMPLE TERRAIN       743.5         100.        0.


***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 7

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	10.00
STK EXIT VELOCITY (M/S)	=	.10
STK GAS EXIT TEMP (K)	=	800.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 15.54 M**4/S**3; MOM. FLUX = .09 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	87.41	4	20.0	20.0	5000.0	8.4	8.3	4.8	NO
200.	73.30	4	20.0	20.0	5000.0	8.4	15.7	8.7	NO
300.	49.84	4	15.0	15.0	4800.0	11.2	22.8	12.5	NO
400.	38.50	4	10.0	10.0	3200.0	16.8	29.8	16.0	NO
500.	31.19	4	8.0	8.0	2560.0	21.0	36.6	19.3	NO
600.	26.63	4	8.0	8.0	2560.0	21.0	43.1	22.0	NO
700.	22.66	4	8.0	8.0	2560.0	21.0	49.6	24.8	NO
800.	19.81	4	5.0	5.0	1600.0	33.5	56.4	28.4	NO
900.	18.27	4	5.0	5.0	1600.0	33.5	62.6	31.0	NO
1000.	16.74	4	5.0	5.0	1600.0	33.5	68.8	33.5	NO
1100.	15.32	4	5.0	5.0	1600.0	33.5	74.9	35.4	NO
1200.	14.06	4	5.0	5.0	1600.0	33.5	81.0	37.3	NO
1300.	13.39	6	4.0	4.0	5000.0	38.8	44.4	19.8	NO
1400.	13.72	6	3.0	3.0	5000.0	42.7	47.6	21.1	NO
1500.	14.12	6	3.0	3.0	5000.0	42.7	50.5	21.8	NO
1600.	14.44	6	3.0	3.0	5000.0	42.7	53.4	22.4	NO
1700.	14.73	6	2.0	2.0	5000.0	48.8	56.7	24.0	NO
1800.	15.10	6	2.0	2.0	5000.0	48.8	59.5	24.6	NO
1900.	15.41	6	2.0	2.0	5000.0	48.8	62.4	25.2	NO
2000.	15.67	6	2.0	2.0	5000.0	48.8	65.2	25.7	NO
2100.	15.76	6	2.0	2.0	5000.0	48.8	68.0	26.2	NO
2200.	15.81	6	2.0	2.0	5000.0	48.8	70.8	26.7	NO
2300.	15.94	6	1.0	1.0	5000.0	61.5	74.4	29.2	NO
2400.	16.16	6	1.0	1.0	5000.0	61.5	77.1	29.7	NO
2500.	16.36	6	1.0	1.0	5000.0	61.5	79.9	30.1	NO
2600.	16.53	6	1.0	1.0	5000.0	61.5	82.7	30.5	NO
2700.	16.68	6	1.0	1.0	5000.0	61.5	85.4	31.0	NO
2800.	16.81	6	1.0	1.0	5000.0	61.5	88.1	31.4	NO
2900.	16.91	6	1.0	1.0	5000.0	61.5	90.8	31.8	NO

3500.	16.87	6	1.0	1.0	5000.0	61.5	107.1	33.9	NO
4000.	16.56	6	1.0	1.0	5000.0	61.5	120.5	35.5	NO
4500.	16.15	6	1.0	1.0	5000.0	61.5	133.7	37.0	NO
5000.	15.68	6	1.0	1.0	5000.0	61.5	146.7	38.5	NO
5500.	15.18	6	1.0	1.0	5000.0	61.5	159.7	39.8	NO
6000.	14.67	6	1.0	1.0	5000.0	61.5	172.5	41.2	NO
6500.	14.16	6	1.0	1.0	5000.0	61.5	185.2	42.5	NO
7000.	13.66	6	1.0	1.0	5000.0	61.5	197.8	43.7	NO
7500.	13.14	6	1.0	1.0	5000.0	61.5	210.3	44.8	NO
8000.	12.65	6	1.0	1.0	5000.0	61.5	222.7	45.8	NO
8500.	12.19	6	1.0	1.0	5000.0	61.5	235.0	46.8	NO
9000.	11.75	6	1.0	1.0	5000.0	61.5	247.2	47.8	NO
9500.	11.34	6	1.0	1.0	5000.0	61.5	259.4	48.7	NO
10000.	10.95	6	1.0	1.0	5000.0	61.5	271.5	49.6	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

125.	95.25	4	20.0	20.0	5000.0	8.4	10.3	5.9	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
*********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	95.25	125.	0.

```
****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****************************************************
```

10-07-94
14:40:43

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 8

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE             =    POINT
   EMISSION RATE (G/S)     =    1.000
   STACK HEIGHT (M)        =      .00
   STK INSIDE DIAM (M)     =    10.00
   STK EXIT VELOCITY (M/S)=     1.00
   STK GAS EXIT TEMP (K)   =   800.00
   AMBIENT AIR TEMP (K)    =   293.00
   RECEPTOR HEIGHT (M)     =      .00
   IOPT (1=URB,2=RUR)      =     2
   BUILDING HEIGHT (M)     =      .00
   MIN HORIZ BLDG DIM (M)  =      .00
   MAX HORIZ BLDG DIM (M)  =      .00
```

BUOY. FLUX = 155.36 M**4/S**3; MOM. FLUX = 9.16 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.4927	6	1.0	1.0	5000.0	132.6	38.1	38.0	NO
200.	.5072	6	1.0	1.0	5000.0	132.6	38.7	38.1	NO
300.	.5596	4	20.0	20.0	5000.0	40.0	23.3	13.3	NO
400.	1.784	4	20.0	20.0	5000.0	40.0	30.2	16.7	NO
500.	2.867	4	20.0	20.0	5000.0	40.0	37.0	19.9	NO
600.	3.491	4	20.0	20.0	5000.0	40.0	43.6	22.9	NO
700.	3.731	4	20.0	20.0	5000.0	40.0	50.1	25.9	NO
800.	3.731	4	20.0	20.0	5000.0	40.0	56.6	28.8	NO
900.	3.598	4	20.0	20.0	5000.0	40.0	62.9	31.6	NO
1000.	3.399	4	20.0	20.0	5000.0	40.0	69.1	34.1	NO
1100.	3.176	4	20.0	20.0	5000.0	40.0	75.2	36.0	NO
1200.	2.965	4	20.0	20.0	5000.0	40.0	81.2	37.9	NO
1300.	2.768	4	20.0	20.0	5000.0	40.0	87.3	39.7	NO
1400.	2.587	4	20.0	20.0	5000.0	40.0	93.3	41.5	NO
1500.	2.421	4	20.0	20.0	5000.0	40.0	99.2	43.2	NO
1600.	2.269	4	20.0	20.0	5000.0	40.0	105.1	44.9	NO
1700.	2.139	4	15.0	15.0	4800.0	53.3	111.5	47.7	NO
1800.	2.047	4	15.0	15.0	4800.0	53.3	117.3	49.3	NO
1900.	1.959	4	15.0	15.0	4800.0	53.3	123.1	50.9	NO
2000.	1.874	4	15.0	15.0	4800.0	53.3	128.8	52.4	NO
2100.	1.795	4	15.0	15.0	4800.0	53.3	134.6	53.9	NO
2200.	1.719	4	15.0	15.0	4800.0	53.3	140.3	55.5	NO
2300.	1.648	4	15.0	15.0	4800.0	53.3	146.0	56.9	NO
2400.	1.580	4	15.0	15.0	4800.0	53.3	151.7	58.4	NO
2500.	1.516	4	15.0	15.0	4800.0	53.3	157.3	59.9	NO
2600.	1.528	5	5.0	5.0	5000.0	93.4	124.3	47.2	NO
2700.	1.543	5	5.0	5.0	5000.0	93.4	128.4	47.9	NO
2800.	1.555	5	5.0	5.0	5000.0	93.4	132.5	48.6	NO
2900.	1.570	5	4.0	4.0	5000.0	100.7	137.0	50.4	NO

3500.	1.648	5	3.0	3.0	5000.0	110.6	161.9	55.9	NO
4000.	1.695	5	2.0	2.0	5000.0	126.8	182.7	61.6	NO
4500.	1.730	5	2.0	2.0	5000.0	126.8	202.4	64.1	NO
5000.	1.748	5	2.0	2.0	5000.0	126.8	221.8	66.5	NO
5500.	1.753	5	2.0	2.0	5000.0	126.8	241.2	68.8	NO
6000.	1.775	5	1.0	1.0	5000.0	159.8	261.8	76.3	NO
6500.	1.805	5	1.0	1.0	5000.0	159.8	280.7	78.3	NO
7000.	1.827	5	1.0	1.0	5000.0	159.8	299.4	80.3	NO
7500.	1.841	5	1.0	1.0	5000.0	159.8	318.1	82.2	NO
8000.	1.850	5	1.0	1.0	5000.0	159.8	336.6	84.1	NO
8500.	1.854	5	1.0	1.0	5000.0	159.8	355.0	86.0	NO
9000.	1.853	5	1.0	1.0	5000.0	159.8	373.2	87.8	NO
9500.	1.849	5	1.0	1.0	5000.0	159.8	391.4	89.6	NO
10000.	1.841	5	1.0	1.0	5000.0	159.8	409.5	91.3	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

747.	3.753	4	20.0	20.0	5000.0	40.0	53.2	27.3	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR   *
*    SIMPLE ELEVATED TERRAIN PROCEDURE      *
*********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
****************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
****************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	3.753	747.	0.

```
****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 9

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 1.000
STACK HEIGHT (M) = .00
STK INSIDE DIAM (M) = 10.00
STK EXIT VELOCITY (M/S)= 3.00
STK GAS EXIT TEMP (K) = 800.00
AMBIENT AIR TEMP (K) = 293.00
RECEPTOR HEIGHT (M) = .00
IOPT (1=URB,2=RUR) = 2
BUILDING HEIGHT (M) = .00
MIN HORIZ BLDG DIM (M) = .00
MAX HORIZ BLDG DIM (M) = .00

BUOY. FLUX = 466.09 M**4/S**3; MOM. FLUX = 82.41 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.2350	6	1.0	1.0	5000.0	191.2	54.8	54.7	NO
200.	.2383	6	1.0	1.0	5000.0	191.2	55.2	54.8	NO
300.	.2423	6	1.0	1.0	5000.0	191.2	55.8	54.9	NO
400.	.2470	6	1.0	1.0	5000.0	191.2	56.6	55.1	NO
500.	.2522	6	1.0	1.0	5000.0	191.2	57.5	55.3	NO
600.	.2580	6	1.0	1.0	5000.0	191.2	58.6	55.5	NO
700.	.2642	6	1.0	1.0	5000.0	191.2	59.9	55.7	NO
800.	.4086	1	3.0	3.0	960.0	515.0	199.4	300.8	NO
900.	.5385	4	20.0	20.0	5000.0	77.2	64.1	33.8	NO
1000.	.6768	1	2.0	2.0	773.5	772.5	273.8	487.2	NO
1100.	.7711	1	2.0	2.0	773.5	772.5	295.3	586.5	NO
1200.	.8070	4	20.0	20.0	5000.0	77.2	82.9	41.3	NO
1300.	.8478	4	20.0	20.0	5000.0	77.2	89.1	43.5	NO
1400.	.8722	4	20.0	20.0	5000.0	77.2	95.1	45.6	NO
1500.	.8736	4	20.0	20.0	5000.0	77.2	101.0	47.2	NO
1600.	.8704	4	20.0	20.0	5000.0	77.2	106.8	48.7	NO
1700.	.8636	4	20.0	20.0	5000.0	77.2	112.6	50.3	NO
1800.	.8538	4	20.0	20.0	5000.0	77.2	118.4	51.8	NO
1900.	.8419	4	20.0	20.0	5000.0	77.2	124.1	53.3	NO
2000.	.8282	4	20.0	20.0	5000.0	77.2	129.8	54.8	NO
2100.	.8132	4	20.0	20.0	5000.0	77.2	135.5	56.3	NO
2200.	.7973	4	20.0	20.0	5000.0	77.2	141.2	57.7	NO
2300.	.7808	4	20.0	20.0	5000.0	77.2	146.9	59.1	NO
2400.	.7639	4	20.0	20.0	5000.0	77.2	152.5	60.6	NO
2500.	.7468	4	20.0	20.0	5000.0	77.2	158.1	62.0	NO
2600.	.7296	4	20.0	20.0	5000.0	77.2	163.7	63.4	NO
2700.	.7124	4	20.0	20.0	5000.0	77.2	169.3	64.7	NO
2800.	.6955	4	20.0	20.0	5000.0	77.2	174.9	66.1	NO
2900.	.6787	4	20.0	20.0	5000.0	77.2	180.4	67.4	NO

3500.	.5852	4	20.0	20.0	5000.0	77.2	213.3	74.6	NO
4000.	.5574	5	5.0	5.0	5000.0	134.8	183.2	62.9	NO
4500.	.5734	5	5.0	5.0	5000.0	134.8	202.8	65.4	NO
5000.	.5840	5	5.0	5.0	5000.0	134.8	222.2	67.7	NO
5500.	.5901	5	5.0	5.0	5000.0	134.8	241.5	70.0	NO
6000.	.5974	5	4.0	4.0	5000.0	145.2	261.1	73.8	NO
6500.	.6018	5	4.0	4.0	5000.0	145.2	280.0	75.9	NO
7000.	.6089	5	3.0	3.0	5000.0	159.8	299.4	80.3	NO
7500.	.6138	5	3.0	3.0	5000.0	159.8	318.1	82.2	NO
8000.	.6168	5	3.0	3.0	5000.0	159.8	336.6	84.1	NO
8500.	.6223	5	2.0	2.0	5000.0	182.9	355.9	89.6	NO
9000.	.6282	5	2.0	2.0	5000.0	182.9	374.1	91.4	NO
9500.	.6327	5	2.0	2.0	5000.0	182.9	392.2	93.1	NO
10000.	.6358	5	2.0	2.0	5000.0	182.9	410.3	94.8	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1477.	.8737	4	20.0	20.0	5000.0	77.2	99.6	46.8	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.8737	1477.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

10-07-94
14:40:49

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 10

SIMPLE TERRAIN INPUTS:

```
   SOURCE TYPE            =    POINT
   EMISSION RATE (G/S)    =    1.000
   STACK HEIGHT (M)       =      .00
   STK INSIDE DIAM (M)    =    10.00
   STK EXIT VELOCITY (M/S)=    10.00
   STK GAS EXIT TEMP (K)  =   800.00
   AMBIENT AIR TEMP (K)   =   293.00
   RECEPTOR HEIGHT (M)    =      .00
   IOPT (1=URB,2=RUR)     =     2
   BUILDING HEIGHT (M)    =      .00
   MIN HORIZ BLDG DIM (M) =      .00
   MAX HORIZ BLDG DIM (M) =      .00
```

BUOY. FLUX = 1553.64 M**4/S**3; MOM. FLUX = 915.63 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.1049	6	1.0	1.0	5000.0	285.7	81.7	81.7	NO
200.	.1055	6	1.0	1.0	5000.0	285.7	82.0	81.7	NO
300.	.1063	6	1.0	1.0	5000.0	285.7	82.4	81.8	NO
400.	.1073	6	1.0	1.0	5000.0	285.7	82.9	81.9	NO
500.	.1083	6	1.0	1.0	5000.0	285.7	83.6	82.0	NO
600.	.1094	6	1.0	1.0	5000.0	285.7	84.3	82.2	NO
700.	.1105	6	1.0	1.0	5000.0	285.7	85.2	82.3	NO
800.	.1115	6	1.0	1.0	5000.0	285.7	86.2	82.5	NO
900.	.1123	6	1.0	1.0	5000.0	285.7	87.2	82.6	NO
1000.	.1482	1	3.0	3.0	1061.5	1060.5	273.3	487.0	NO
1100.	.2384	1	3.0	3.0	1061.5	1060.5	294.8	586.3	NO
1200.	.3021	1	3.0	3.0	1061.5	1060.5	315.9	696.7	NO
1300.	.3325	1	3.0	3.0	1061.5	1060.5	336.6	818.3	NO
1400.	.3374	1	3.0	3.0	1061.5	1060.5	357.1	951.1	NO
1500.	.3285	1	3.0	3.0	1061.5	1060.5	377.3	1095.3	NO
1600.	.3147	1	3.0	3.0	1061.5	1060.5	397.3	1250.8	NO
1700.	.3003	1	3.0	3.0	1061.5	1060.5	417.0	1417.8	NO
1800.	.2870	1	3.0	3.0	1061.5	1060.5	436.6	1596.3	NO
1900.	.2748	1	3.0	3.0	1061.5	1060.5	455.9	1786.4	NO
2000.	.2637	1	3.0	3.0	1061.5	1060.5	475.0	1988.1	NO
2100.	.2536	1	3.0	3.0	1061.5	1060.5	494.0	2201.4	NO
2200.	.2443	1	3.0	3.0	1061.5	1060.5	512.8	2426.6	NO
2300.	.2369	1	3.0	3.0	1061.5	1060.5	528.9	2663.0	NO
2400.	.2310	1	3.0	3.0	1061.5	1060.5	542.4	2910.9	NO
2500.	.2253	1	3.0	3.0	1061.5	1060.5	556.0	3170.9	NO
2600.	.2199	1	3.0	3.0	1061.5	1060.5	569.6	3443.0	NO
2700.	.2148	1	3.0	3.0	1061.5	1060.5	583.4	3727.1	NO
2800.	.2098	1	3.0	3.0	1061.5	1060.5	597.1	4023.5	NO
2900.	.2051	1	3.0	3.0	1061.5	1060.5	610.9	4332.0	NO

3500.	.1804	1	3.0	3.0	1061.5	1060.5	694.3	5000.0	NO
4000.	.1640	1	3.0	3.0	1061.5	1060.5	764.0	5000.0	NO
4500.	.1522	4	20.0	20.0	5000.0	159.1	269.9	94.8	NO
5000.	.1509	4	20.0	20.0	5000.0	159.1	296.0	99.7	NO
5500.	.1555	5	5.0	5.0	5000.0	201.3	245.3	82.0	NO
6000.	.1615	5	5.0	5.0	5000.0	201.3	264.1	83.9	NO
6500.	.1669	5	5.0	5.0	5000.0	201.3	282.8	85.8	NO
7000.	.1717	5	5.0	5.0	5000.0	201.3	301.5	87.6	NO
7500.	.1759	5	5.0	5.0	5000.0	201.3	320.0	89.4	NO
8000.	.1797	5	5.0	5.0	5000.0	201.3	338.4	91.1	NO
8500.	.1829	5	5.0	5.0	5000.0	201.3	356.7	92.8	NO
9000.	.1858	5	5.0	5.0	5000.0	201.3	374.9	94.5	NO
9500.	.1882	5	5.0	5.0	5000.0	201.3	393.0	96.2	NO
10000.	.1903	5	5.0	5.0	5000.0	201.3	411.0	97.8	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1375.	.3379	1	3.0	3.0	1061.5	1060.5	351.8	915.5	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.3379	1375.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

```
 *** SCREEN-1.1 MODEL RUN ***
 *** VERSION DATED  88300 ***

OD non-flare case, RUN 11

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE            =    POINT
   EMISSION RATE (G/S)    =    1.000
   STACK HEIGHT (M)       =      .00
   STK INSIDE DIAM (M)    =    10.00
   STK EXIT VELOCITY (M/S)=    20.00
   STK GAS EXIT TEMP (K)  =   800.00
   AMBIENT AIR TEMP (K)   =   293.00
   RECEPTOR HEIGHT (M)    =      .00
   IOPT (1=URB,2=RUR)     =     2
   BUILDING HEIGHT (M)    =      .00
   MIN HORIZ BLDG DIM (M) =      .00
   MAX HORIZ BLDG DIM (M) =      .00


BUOY. FLUX = 3107.28 M**4/S**3;  MOM. FLUX = 3662.50 M**4/S**2.

*** FULL METEOROLOGY ***

**********************************
*** SCREEN AUTOMATED DISTANCES ***
**********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.6598E-01	6	1.0	1.0	5000.0	359.9	102.9	102.9	NO
200.	.6625E-01	6	1.0	1.0	5000.0	359.9	103.1	102.9	NO
300.	.6656E-01	6	1.0	1.0	5000.0	359.9	103.4	103.0	NO
400.	.6693E-01	6	1.0	1.0	5000.0	359.9	103.9	103.1	NO
500.	.6732E-01	6	1.0	1.0	5000.0	359.9	104.4	103.2	NO
600.	.6775E-01	6	1.0	1.0	5000.0	359.9	105.0	103.3	NO
700.	.6821E-01	6	1.0	1.0	5000.0	359.9	105.7	103.4	NO
800.	.6856E-01	6	1.0	1.0	5000.0	359.9	106.5	103.5	NO
900.	.6890E-01	6	1.0	1.0	5000.0	359.9	107.3	103.6	NO
1000.	.6923E-01	6	1.0	1.0	5000.0	359.9	108.3	103.8	NO
1100.	.6947E-01	6	1.0	1.0	5000.0	359.9	109.3	103.9	NO
1200.	.6970E-01	6	1.0	1.0	5000.0	359.9	110.3	104.0	NO
1300.	.1062	1	3.0	3.0	1608.4	1607.4	373.2	834.0	NO
1400.	.1390	1	3.0	3.0	1608.4	1607.4	395.2	966.1	NO
1500.	.1605	1	3.0	3.0	1608.4	1607.4	416.9	1109.5	NO
1600.	.1708	1	3.0	3.0	1608.4	1607.4	438.3	1264.4	NO
1700.	.1727	1	3.0	3.0	1608.4	1607.4	459.4	1430.8	NO
1800.	.1697	1	3.0	3.0	1608.4	1607.4	480.3	1608.8	NO
1900.	.1644	1	3.0	3.0	1608.4	1607.4	500.9	1798.4	NO
2000.	.1584	1	3.0	3.0	1608.4	1607.4	521.3	1999.6	NO
2100.	.1527	1	3.0	3.0	1608.4	1607.4	541.5	2212.6	NO
2200.	.1472	1	3.0	3.0	1608.4	1607.4	561.5	2437.4	NO
2300.	.1422	1	3.0	3.0	1608.4	1607.4	581.4	2673.9	NO
2400.	.1376	1	3.0	3.0	1608.4	1607.4	601.0	2922.4	NO
2500.	.1332	1	3.0	3.0	1608.4	1607.4	620.5	3182.9	NO
2600.	.1292	1	3.0	3.0	1608.4	1607.4	639.9	3455.3	NO
2700.	.1254	1	3.0	3.0	1608.4	1607.4	659.1	3739.7	NO
2800.	.1219	1	3.0	3.0	1608.4	1607.4	678.1	4036.3	NO
2900.	.1186	1	3.0	3.0	1608.4	1607.4	697.1	4345.0	NO

3500.	.1066	1	3.0	3.0	1608.4	1607.4	775.3	5000.0	NO
4000.	.9862E-01	1	3.0	3.0	1608.4	1607.4	838.3	5000.0	NO
4500.	.9164E-01	1	3.0	3.0	1608.4	1607.4	902.2	5000.0	NO
5000.	.8553E-01	1	3.0	3.0	1608.4	1607.4	966.6	5000.0	NO
5500.	.8017E-01	1	3.0	3.0	1608.4	1607.4	1031.3	5000.0	NO
6000.	.7543E-01	1	3.0	3.0	1608.4	1607.4	1096.1	5000.0	NO
6500.	.7509E-01	2	4.0	4.0	1280.0	1205.6	877.4	919.0	NO
7000.	.7521E-01	2	4.0	4.0	1280.0	1205.6	927.3	986.3	NO
7500.	.7744E-01	5	5.0	5.0	5000.0	253.6	323.0	99.6	NO
8000.	.7973E-01	5	5.0	5.0	5000.0	253.6	341.3	101.2	NO
8500.	.8189E-01	5	5.0	5.0	5000.0	253.6	359.4	102.7	NO
9000.	.8394E-01	5	5.0	5.0	5000.0	253.6	377.5	104.3	NO
9500.	.8586E-01	5	5.0	5.0	5000.0	253.6	395.4	105.8	NO
10000.	.8766E-01	5	5.0	5.0	5000.0	253.6	413.3	107.3	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1679.	.1728	1	3.0	3.0	1608.4	1607.4	454.8	1393.2	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
* SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *
* SIMPLE ELEVATED TERRAIN PROCEDURE *
****

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.1728	1679.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 12

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	10.00
STK EXIT VELOCITY (M/S)	=	3.00
STK GAS EXIT TEMP (K)	=	400.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 196.73 M**4/S**3; MOM. FLUX = 164.81 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.4200	6	1.0	1.0	5000.0	143.4	41.2	41.1	NO
200.	.4306	6	1.0	1.0	5000.0	143.4	41.7	41.2	NO
300.	.4435	6	1.0	1.0	5000.0	143.4	42.5	41.4	NO
400.	.7565	4	20.0	20.0	5000.0	46.0	30.3	16.9	NO
500.	1.556	4	20.0	20.0	5000.0	46.0	37.1	20.1	NO
600.	2.196	4	20.0	20.0	5000.0	46.0	43.8	23.2	NO
700.	2.584	4	20.0	20.0	5000.0	46.0	50.3	26.2	NO
800.	2.762	4	20.0	20.0	5000.0	46.0	56.7	29.1	NO
900.	2.796	4	20.0	20.0	5000.0	46.0	63.1	32.0	NO
1000.	2.741	4	20.0	20.0	5000.0	46.0	69.4	34.7	NO
1100.	2.611	4	20.0	20.0	5000.0	46.0	75.5	36.6	NO
1200.	2.479	4	20.0	20.0	5000.0	46.0	81.5	38.4	NO
1300.	2.348	4	20.0	20.0	5000.0	46.0	87.5	40.2	NO
1400.	2.223	4	20.0	20.0	5000.0	46.0	93.5	42.0	NO
1500.	2.103	4	20.0	20.0	5000.0	46.0	99.4	43.7	NO
1600.	1.991	4	20.0	20.0	5000.0	46.0	105.3	45.4	NO
1700.	1.885	4	20.0	20.0	5000.0	46.0	111.2	47.0	NO
1800.	1.786	4	20.0	20.0	5000.0	46.0	117.0	48.7	NO
1900.	1.695	4	20.0	20.0	5000.0	46.0	122.8	50.3	NO
2000.	1.609	4	20.0	20.0	5000.0	46.0	128.6	51.8	NO
2100.	1.532	4	15.0	15.0	4800.0	61.4	134.9	54.6	NO
2200.	1.479	4	15.0	15.0	4800.0	61.4	140.6	56.1	NO
2300.	1.428	4	15.0	15.0	4800.0	61.4	146.3	57.6	NO
2400.	1.378	4	15.0	15.0	4800.0	61.4	151.9	59.1	NO
2500.	1.330	4	15.0	15.0	4800.0	61.4	157.6	60.5	NO
2600.	1.285	4	15.0	15.0	4800.0	61.4	163.2	61.9	NO
2700.	1.241	4	15.0	15.0	4800.0	61.4	168.8	63.3	NO
2800.	1.226	5	5.0	5.0	5000.0	101.1	133.0	49.8	NO
2900.	1.240	5	5.0	5.0	5000.0	101.1	137.0	50.5	NO

3500.	1.301	5	4.0	4.0	5000.0	108.9	161.8	55.6	NO
4000.	1.346	5	3.0	3.0	5000.0	119.9	182.3	60.4	NO
4500.	1.362	5	3.0	3.0	5000.0	119.9	202.0	63.0	NO
5000.	1.382	5	2.0	2.0	5000.0	137.2	222.3	68.1	NO
5500.	1.400	5	2.0	2.0	5000.0	137.2	241.6	70.4	NO
6000.	1.409	5	2.0	2.0	5000.0	137.2	260.7	72.6	NO
6500.	1.411	5	2.0	2.0	5000.0	137.2	279.7	74.7	NO
7000.	1.429	5	1.0	1.0	5000.0	172.9	300.0	82.5	NO
7500.	1.450	5	1.0	1.0	5000.0	172.9	318.6	84.3	NO
8000.	1.466	5	1.0	1.0	5000.0	172.9	337.1	86.2	NO
8500.	1.478	5	1.0	1.0	5000.0	172.9	355.5	88.0	NO
9000.	1.486	5	1.0	1.0	5000.0	172.9	373.7	89.8	NO
9500.	1.491	5	1.0	1.0	5000.0	172.9	391.9	91.5	NO
10000.	1.493	5	1.0	1.0	5000.0	172.9	409.9	93.2	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

881.	2.798	4	20.0	20.0	5000.0	46.0	62.0	31.5	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	2.798	881.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 13

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 1.000
STACK HEIGHT (M) = .00
STK INSIDE DIAM (M) = 10.00
STK EXIT VELOCITY (M/S)= 3.00
STK GAS EXIT TEMP (K) = 800.00
AMBIENT AIR TEMP (K) = 293.00
RECEPTOR HEIGHT (M) = .00
IOPT (1=URB,2=RUR) = 2
BUILDING HEIGHT (M) = .00
MIN HORIZ BLDG DIM (M) = .00
MAX HORIZ BLDG DIM (M) = .00

BUOY. FLUX = 466.09 M**4/S**3; MOM. FLUX = 82.41 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.2350	6	1.0	1.0	5000.0	191.2	54.8	54.7	NO
200.	.2383	6	1.0	1.0	5000.0	191.2	55.2	54.8	NO
300.	.2423	6	1.0	1.0	5000.0	191.2	55.8	54.9	NO
400.	.2470	6	1.0	1.0	5000.0	191.2	56.6	55.1	NO
500.	.2522	6	1.0	1.0	5000.0	191.2	57.5	55.3	NO
600.	.2580	6	1.0	1.0	5000.0	191.2	58.6	55.5	NO
700.	.2642	6	1.0	1.0	5000.0	191.2	59.9	55.7	NO
800.	.4086	1	3.0	3.0	960.0	515.0	199.4	300.8	NO
900.	.5385	4	20.0	20.0	5000.0	77.2	64.1	33.8	NO
1000.	.6768	1	2.0	2.0	773.5	772.5	273.8	487.2	NO
1100.	.7711	1	2.0	2.0	773.5	772.5	295.3	586.5	NO
1200.	.8070	4	20.0	20.0	5000.0	77.2	82.9	41.3	NO
1300.	.8478	4	20.0	20.0	5000.0	77.2	89.1	43.5	NO
1400.	.8722	4	20.0	20.0	5000.0	77.2	95.1	45.6	NO
1500.	.8736	4	20.0	20.0	5000.0	77.2	101.0	47.2	NO
1600.	.8704	4	20.0	20.0	5000.0	77.2	106.8	48.7	NO
1700.	.8636	4	20.0	20.0	5000.0	77.2	112.6	50.3	NO
1800.	.8538	4	20.0	20.0	5000.0	77.2	118.4	51.8	NO
1900.	.8419	4	20.0	20.0	5000.0	77.2	124.1	53.3	NO
2000.	.8282	4	20.0	20.0	5000.0	77.2	129.8	54.8	NO
2100.	.8132	4	20.0	20.0	5000.0	77.2	135.5	56.3	NO
2200.	.7973	4	20.0	20.0	5000.0	77.2	141.2	57.7	NO
2300.	.7808	4	20.0	20.0	5000.0	77.2	146.9	59.1	NO
2400.	.7639	4	20.0	20.0	5000.0	77.2	152.5	60.6	NO
2500.	.7468	4	20.0	20.0	5000.0	77.2	158.1	62.0	NO
2600.	.7296	4	20.0	20.0	5000.0	77.2	163.7	63.4	NO
2700.	.7124	4	20.0	20.0	5000.0	77.2	169.3	64.7	NO
2800.	.6955	4	20.0	20.0	5000.0	77.2	174.9	66.1	NO
2900.	.6787	4	20.0	20.0	5000.0	77.2	180.4	67.4	NO

3500.	.5852	4	20.0	20.0	5000.0	77.2	213.3	74.8	NO
4000.	.5574	5	5.0	5.0	5000.0	134.8	183.2	62.9	NO
4500.	.5734	5	5.0	5.0	5000.0	134.8	202.8	65.4	NO
5000.	.5840	5	5.0	5.0	5000.0	134.8	222.2	67.7	NO
5500.	.5901	5	5.0	5.0	5000.0	134.8	241.5	70.0	NO
6000.	.5974	5	4.0	4.0	5000.0	145.2	261.1	73.8	NO
6500.	.6018	5	4.0	4.0	5000.0	145.2	280.0	75.9	NO
7000.	.6089	5	3.0	3.0	5000.0	159.8	299.4	80.3	NO
7500.	.6138	5	3.0	3.0	5000.0	159.8	318.1	82.2	NO
8000.	.6168	5	3.0	3.0	5000.0	159.8	336.6	84.1	NO
8500.	.6223	5	2.0	2.0	5000.0	182.9	355.9	89.6	NO
9000.	.6282	5	2.0	2.0	5000.0	182.9	374.1	91.4	NO
9500.	.6327	5	2.0	2.0	5000.0	182.9	392.2	93.1	NO
10000.	.6358	5	2.0	2.0	5000.0	182.9	410.3	94.8	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1477.	.8737	4	20.0	20.0	5000.0	77.2	99.6	46.8	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.8737	1477.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 14

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	10.00
STK EXIT VELOCITY (M/S)	=	3.00
STK GAS EXIT TEMP (K)	=	1000.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 519.96 M**4/S**3; MOM. FLUX = 65.93 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.2183	6	1.0	1.0	5000.0	198.3	56.8	56.7	NO
200.	.2212	6	1.0	1.0	5000.0	198.3	57.2	56.8	NO
300.	.2247	6	1.0	1.0	5000.0	198.3	57.8	56.9	NO
400.	.2287	6	1.0	1.0	5000.0	198.3	58.5	57.1	NO
500.	.2332	6	1.0	1.0	5000.0	198.3	59.4	57.3	NO
600.	.2382	6	1.0	1.0	5000.0	198.3	60.5	57.5	NO
700.	.2435	6	1.0	1.0	5000.0	198.3	61.7	57.7	NO
800.	.3328	1	3.0	3.0	960.0	549.9	201.3	302.1	NO
900.	.4445	1	3.0	3.0	960.0	549.9	221.8	380.7	NO
1000.	.5637	1	2.0	2.0	825.9	824.9	278.1	489.7	NO
1100.	.6746	1	2.0	2.0	825.9	824.9	299.8	588.8	NO
1200.	.7083	1	2.0	2.0	825.9	824.9	321.1	699.1	NO
1300.	.6951	1	2.0	2.0	825.9	824.9	342.1	820.6	NO
1400.	.7275	4	20.0	20.0	5000.0	82.5	95.4	46.0	NO
1500.	.7436	4	20.0	20.0	5000.0	82.5	101.3	47.9	NO
1600.	.7467	4	20.0	20.0	5000.0	82.5	107.1	49.4	NO
1700.	.7461	4	20.0	20.0	5000.0	82.5	112.9	50.9	NO
1800.	.7427	4	20.0	20.0	5000.0	82.5	118.6	52.5	NO
1900.	.7369	4	20.0	20.0	5000.0	82.5	124.4	53.9	NO
2000.	.7291	4	20.0	20.0	5000.0	82.5	130.1	55.4	NO
2100.	.7198	4	20.0	20.0	5000.0	82.5	135.8	56.9	NO
2200.	.7093	4	20.0	20.0	5000.0	82.5	141.5	58.3	NO
2300.	.6979	4	20.0	20.0	5000.0	82.5	147.1	59.7	NO
2400.	.6858	4	20.0	20.0	5000.0	82.5	152.7	61.1	NO
2500.	.6732	4	20.0	20.0	5000.0	82.5	158.4	62.5	NO
2600.	.6603	4	20.0	20.0	5000.0	82.5	163.9	63.9	NO
2700.	.6471	4	20.0	20.0	5000.0	82.5	169.5	65.2	NO
2800.	.6339	4	20.0	20.0	5000.0	82.5	175.1	66.6	NO
2900.	.6206	4	20.0	20.0	5000.0	82.5	180.6	67.9	NO

3500.	.5433	4	20.0	20.0	5000.0	82.5	213.5	73.3	NO
4000.	.4938	5	5.0	5.0	5000.0	139.8	183.5	63.8	NO
4500.	.5103	5	5.0	5.0	5000.0	139.8	203.0	66.2	NO
5000.	.5220	5	5.0	5.0	5000.0	139.8	222.5	68.5	NO
5500.	.5298	5	5.0	5.0	5000.0	139.8	241.7	70.8	NO
6000.	.5349	5	4.0	4.0	5000.0	150.6	261.3	74.7	NO
6500.	.5408	5	4.0	4.0	5000.0	150.6	280.3	76.8	NO
7000.	.5444	5	3.0	3.0	5000.0	165.7	299.7	81.3	NO
7500.	.5505	5	3.0	3.0	5000.0	165.7	318.3	83.2	NO
8000.	.5548	5	3.0	3.0	5000.0	165.7	336.8	85.0	NO
8500.	.5575	5	3.0	3.0	5000.0	165.7	355.2	86.9	NO
9000.	.5614	5	2.0	2.0	5000.0	189.7	374.4	92.5	NO
9500.	.5667	5	2.0	2.0	5000.0	189.7	392.5	94.2	NO
10000.	.5709	5	2.0	2.0	5000.0	189.7	410.5	95.9	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1633.	.7468	4	20.0	20.0	5000.0	82.5	109.0	49.9	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.7468	1633.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 15

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = POINT
EMISSION RATE (G/S) = 1.000
STACK HEIGHT (M) = .00
STK INSIDE DIAM (M) = 10.00
STK EXIT VELOCITY (M/S)= 3.00
STK GAS EXIT TEMP (K) = 1500.00
AMBIENT AIR TEMP (K) = 293.00
RECEPTOR HEIGHT (M) = .00
IOPT (1=URB,2=RUR) = 2
BUILDING HEIGHT (M) = .00
MIN HORIZ BLDG DIM (M) = .00
MAX HORIZ BLDG DIM (M) = .00

BUOY. FLUX = 591.79 M**4/S**3; MOM. FLUX = 43.95 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.2002	6	1.0	1.0	5000.0	207.1	59.3	59.2	NO
200.	.2026	6	1.0	1.0	5000.0	207.1	59.7	59.3	NO
300.	.2055	6	1.0	1.0	5000.0	207.1	60.2	59.4	NO
400.	.2089	6	1.0	1.0	5000.0	207.1	60.9	59.6	NO
500.	.2127	6	1.0	1.0	5000.0	207.1	61.8	59.8	NO
600.	.2168	6	1.0	1.0	5000.0	207.1	62.9	60.0	NO
700.	.2213	6	1.0	1.0	5000.0	207.1	64.0	60.2	NO
800.	.2529	1	3.0	3.0	960.0	594.3	203.8	303.7	NO
900.	.3722	1	3.0	3.0	960.0	594.3	224.5	382.2	NO
1000.	.4419	1	2.0	2.0	892.4	891.4	283.5	492.8	NO
1100.	.5647	1	2.0	2.0	892.4	891.4	305.5	591.8	NO
1200.	.6187	1	2.0	2.0	892.4	891.4	327.1	701.9	NO
1300.	.6223	1	2.0	2.0	892.4	891.4	348.4	823.2	NO
1400.	.6009	1	2.0	2.0	892.4	891.4	369.4	955.8	NO
1500.	.6008	4	20.0	20.0	5000.0	89.1	101.7	48.7	NO
1600.	.6132	4	20.0	20.0	5000.0	89.1	107.6	50.4	NO
1700.	.6180	4	20.0	20.0	5000.0	89.1	113.3	51.9	NO
1800.	.6201	4	20.0	20.0	5000.0	89.1	119.0	53.3	NO
1900.	.6199	4	20.0	20.0	5000.0	89.1	124.8	54.8	NO
2000.	.6178	4	20.0	20.0	5000.0	89.1	130.5	56.2	NO
2100.	.6140	4	20.0	20.0	5000.0	89.1	136.1	57.7	NO
2200.	.6088	4	20.0	20.0	5000.0	89.1	141.8	59.1	NO
2300.	.6026	4	20.0	20.0	5000.0	89.1	147.4	60.5	NO
2400.	.5954	4	20.0	20.0	5000.0	89.1	153.0	61.9	NO
2500.	.5875	4	20.0	20.0	5000.0	89.1	158.6	63.3	NO
2600.	.5791	4	20.0	20.0	5000.0	89.1	164.2	64.6	NO
2700.	.5701	4	20.0	20.0	5000.0	89.1	169.8	66.0	NO
2800.	.5609	4	20.0	20.0	5000.0	89.1	175.3	67.3	NO
2900.	.5514	4	20.0	20.0	5000.0	89.1	180.9	68.6	NO

3500.	.4922	4	20.0	20.0	5000.0	89.1	213.7	75.9	NO
4000.	.4462	4	20.0	20.0	5000.0	89.1	240.7	81.6	NO
4500.	.4429	5	5.0	5.0	5000.0	145.9	203.4	67.3	NO
5000.	.4554	5	5.0	5.0	5000.0	145.9	222.8	69.6	NO
5500.	.4644	5	5.0	5.0	5000.0	145.9	242.0	71.8	NO
6000.	.4705	5	5.0	5.0	5000.0	145.9	261.1	74.0	NO
6500.	.4746	5	4.0	4.0	5000.0	157.2	280.6	77.9	NO
7000.	.4796	5	4.0	4.0	5000.0	157.2	299.3	79.9	NO
7500.	.4828	5	4.0	4.0	5000.0	157.2	318.0	81.8	NO
8000.	.4874	5	3.0	3.0	5000.0	173.0	337.1	86.2	NO
8500.	.4914	5	3.0	3.0	5000.0	173.0	355.5	88.0	NO
9000.	.4941	5	3.0	3.0	5000.0	173.0	373.7	89.8	NO
9500.	.4957	5	3.0	3.0	5000.0	173.0	391.9	91.5	NO
10000.	.5004	5	2.0	2.0	5000.0	198.1	410.8	97.2	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1257.	.6252	1	2.0	2.0	892.4	891.4	339.1	768.4	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.6252	1257.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 16

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	10.00
STK EXIT VELOCITY (M/S)	=	3.00
STK GAS EXIT TEMP (K)	=	2000.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 627.71 M**4/S**3; MOM. FLUX = 32.96 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.1924	6	1.0	1.0	5000.0	211.2	60.5	60.4	NO
200.	.1947	6	1.0	1.0	5000.0	211.2	60.8	60.5	NO
300.	.1974	6	1.0	1.0	5000.0	211.2	61.4	60.6	NO
400.	.2005	6	1.0	1.0	5000.0	211.2	62.1	60.7	NO
500.	.2040	6	1.0	1.0	5000.0	211.2	63.0	60.9	NO
600.	.2078	6	1.0	1.0	5000.0	211.2	64.0	61.1	NO
700.	.2119	6	1.0	1.0	5000.0	211.2	65.1	61.3	NO
800.	.2203	1	3.0	3.0	960.0	615.7	205.0	304.5	NO
900.	.3408	1	3.0	3.0	960.0	615.7	225.7	383.0	NO
1000.	.4103	1	3.0	3.0	960.0	615.7	246.1	472.2	NO
1100.	.5168	1	2.0	2.0	924.5	923.5	308.2	593.2	NO
1200.	.5786	1	2.0	2.0	924.5	923.5	330.0	703.2	NO
1300.	.5897	1	2.0	2.0	924.5	923.5	351.4	824.5	NO
1400.	.5734	1	2.0	2.0	924.5	923.5	372.5	957.0	NO
1500.	.5476	1	2.0	2.0	924.5	923.5	393.3	1100.9	NO
1600.	.5575	4	20.0	20.0	5000.0	92.4	107.8	50.8	NO
1700.	.5641	4	20.0	20.0	5000.0	92.4	113.5	52.3	NO
1800.	.5681	4	20.0	20.0	5000.0	92.4	119.2	53.8	NO
1900.	.5699	4	20.0	20.0	5000.0	92.4	124.9	55.2	NO
2000.	.5698	4	20.0	20.0	5000.0	92.4	130.6	56.7	NO
2100.	.5680	4	20.0	20.0	5000.0	92.4	136.3	58.1	NO
2200.	.5649	4	20.0	20.0	5000.0	92.4	142.0	59.5	NO
2300.	.5606	4	20.0	20.0	5000.0	92.4	147.6	60.9	NO
2400.	.5554	4	20.0	20.0	5000.0	92.4	153.2	62.3	NO
2500.	.5494	4	20.0	20.0	5000.0	92.4	158.8	63.6	NO
2600.	.5427	4	20.0	20.0	5000.0	92.4	164.4	65.0	NO
2700.	.5356	4	20.0	20.0	5000.0	92.4	169.9	66.3	NO
2800.	.5280	4	20.0	20.0	5000.0	92.4	175.5	67.6	NO
2900.	.5201	4	20.0	20.0	5000.0	92.4	181.0	69.0	NO

3500.	.4686	4	20.0	20.0	5000.0	92.4	215.6	78.2	NO
4000.	.4274	4	20.0	20.0	5000.0	92.4	240.8	81.9	NO
4500.	.4148	5	5.0	5.0	5000.0	148.8	203.6	67.8	NO
5000.	.4274	5	5.0	5.0	5000.0	148.8	223.0	70.1	NO
5500.	.4367	5	5.0	5.0	5000.0	148.8	242.2	72.3	NO
6000.	.4434	5	5.0	5.0	5000.0	148.8	261.3	74.4	NO
6500.	.4478	5	5.0	5.0	5000.0	148.8	280.2	76.5	NO
7000.	.4521	5	4.0	4.0	5000.0	160.3	299.5	80.4	NO
7500.	.4559	5	4.0	4.0	5000.0	160.3	318.1	82.3	NO
8000.	.4588	5	3.0	3.0	5000.0	176.5	337.3	86.8	NO
8500.	.4632	5	3.0	3.0	5000.0	176.5	355.6	88.6	NO
9000.	.4664	5	3.0	3.0	5000.0	176.5	373.9	90.3	NO
9500.	.4686	5	3.0	3.0	5000.0	176.5	392.0	92.1	NO
10000.	.4707	5	2.0	2.0	5000.0	202.0	411.0	97.9	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1278.	.5904	1	2.0	2.0	924.5	923.5	346.5	795.6	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
* SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *
* SIMPLE ELEVATED TERRAIN PROCEDURE *
****

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.5904	1278.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 17

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	10.00
STK EXIT VELOCITY (M/S)	=	3.00
STK GAS EXIT TEMP (K)	=	800.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 466.09 M**4/S**3; MOM. FLUX = 82.41 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.2350	6	1.0	1.0	5000.0	191.2	54.8	54.7	NO
200.	.2383	6	1.0	1.0	5000.0	191.2	55.2	54.8	NO
300.	.2423	6	1.0	1.0	5000.0	191.2	55.8	54.9	NO
400.	.2470	6	1.0	1.0	5000.0	191.2	56.6	55.1	NO
500.	.2522	6	1.0	1.0	5000.0	191.2	57.5	55.3	NO
600.	.2580	6	1.0	1.0	5000.0	191.2	58.6	55.5	NO
700.	.2642	6	1.0	1.0	5000.0	191.2	59.9	55.7	NO
800.	.4086	1	3.0	3.0	960.0	515.0	199.4	300.8	NO
900.	.5385	4	20.0	20.0	5000.0	77.2	64.1	33.8	NO
1000.	.6768	1	2.0	2.0	773.5	772.5	273.8	487.2	NO
1100.	.7711	1	2.0	2.0	773.5	772.5	295.3	586.5	NO
1200.	.8070	4	20.0	20.0	5000.0	77.2	82.9	41.3	NO
1300.	.8478	4	20.0	20.0	5000.0	77.2	89.1	43.5	NO
1400.	.8722	4	20.0	20.0	5000.0	77.2	95.1	45.6	NO
1500.	.8736	4	20.0	20.0	5000.0	77.2	101.0	47.2	NO
1600.	.8704	4	20.0	20.0	5000.0	77.2	106.8	48.7	NO
1700.	.8636	4	20.0	20.0	5000.0	77.2	112.6	50.3	NO
1800.	.8538	4	20.0	20.0	5000.0	77.2	118.4	51.8	NO
1900.	.8419	4	20.0	20.0	5000.0	77.2	124.1	53.3	NO
2000.	.8282	4	20.0	20.0	5000.0	77.2	129.8	54.8	NO
2100.	.8132	4	20.0	20.0	5000.0	77.2	135.5	56.3	NO
2200.	.7973	4	20.0	20.0	5000.0	77.2	141.2	57.7	NO
2300.	.7808	4	20.0	20.0	5000.0	77.2	146.9	59.1	NO
2400.	.7639	4	20.0	20.0	5000.0	77.2	152.5	60.6	NO
2500.	.7468	4	20.0	20.0	5000.0	77.2	158.1	62.0	NO
2600.	.7296	4	20.0	20.0	5000.0	77.2	163.7	63.4	NO
2700.	.7124	4	20.0	20.0	5000.0	77.2	169.3	64.7	NO
2800.	.6955	4	20.0	20.0	5000.0	77.2	174.9	66.1	NO
2900.	.6787	4	20.0	20.0	5000.0	77.2	180.4	67.4	NO

3500.	.5652	4	20.0	20.0	5000.0	77.2	213.3	74.8	NO
4000.	.5574	5	5.0	5.0	5000.0	134.8	183.2	62.9	NO
4500.	.5734	5	5.0	5.0	5000.0	134.8	202.8	65.4	NO
5000.	.5840	5	5.0	5.0	5000.0	134.8	222.2	67.7	NO
5500.	.5901	5	5.0	5.0	5000.0	134.8	241.5	70.0	NO
6000.	.5974	5	4.0	4.0	5000.0	145.2	261.1	73.8	NO
6500.	.6018	5	4.0	4.0	5000.0	145.2	280.0	75.9	NO
7000.	.6089	5	3.0	3.0	5000.0	159.8	299.4	80.3	NO
7500.	.6138	5	3.0	3.0	5000.0	159.8	318.1	82.2	NO
8000.	.6168	5	3.0	3.0	5000.0	159.8	336.6	84.1	NO
8500.	.6223	5	2.0	2.0	5000.0	182.9	355.9	89.6	NO
9000.	.6282	5	2.0	2.0	5000.0	182.9	374.1	91.4	NO
9500.	.6327	5	2.0	2.0	5000.0	182.9	392.2	93.1	NO
10000.	.6358	5	2.0	2.0	5000.0	182.9	410.3	94.8	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1477.	.8737	4	20.0	20.0	5000.0	77.2	99.6	46.8	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.8737	1477.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

10-07-94
14:41:10

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

OD non-flare case, RUN 18

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	.00
STK INSIDE DIAM (M)	=	10.00
STK EXIT VELOCITY (M/S)	=	3.00
STK GAS EXIT TEMP (K)	=	800.00
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	1.50
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.00
MIN HORIZ BLDG DIM (M)	=	.00
MAX HORIZ BLDG DIM (M)	=	.00

BUOY. FLUX = 466.09 M**4/S**3; MOM. FLUX = 82.41 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.2360	6	1.0	1.0	5000.0	191.2	54.8	54.7	NO
200.	.2393	6	1.0	1.0	5000.0	191.2	55.2	54.8	NO
300.	.2433	6	1.0	1.0	5000.0	191.2	55.8	54.9	NO
400.	.2480	6	1.0	1.0	5000.0	191.2	56.6	55.1	NO
500.	.2533	6	1.0	1.0	5000.0	191.2	57.5	55.3	NO
600.	.2590	6	1.0	1.0	5000.0	191.2	58.6	55.5	NO
700.	.2653	6	1.0	1.0	5000.0	191.2	59.9	55.7	NO
800.	.4086	1	3.0	3.0	960.0	515.0	199.4	300.8	NO
900.	.5407	4	20.0	20.0	5000.0	77.2	64.1	33.8	NO
1000.	.6768	1	2.0	2.0	773.5	772.5	273.8	487.2	NO
1100.	.7711	1	2.0	2.0	773.5	772.5	295.3	586.5	NO
1200.	.8084	4	20.0	20.0	5000.0	77.2	82.9	41.3	NO
1300.	.8489	4	20.0	20.0	5000.0	77.2	89.1	43.5	NO
1400.	.8731	4	20.0	20.0	5000.0	77.2	95.1	45.6	NO
1500.	.8743	4	20.0	20.0	5000.0	77.2	101.0	47.2	NO
1600.	.8710	4	20.0	20.0	5000.0	77.2	106.8	48.7	NO
1700.	.8641	4	20.0	20.0	5000.0	77.2	112.6	50.3	NO
1800.	.8543	4	20.0	20.0	5000.0	77.2	118.4	51.8	NO
1900.	.8422	4	20.0	20.0	5000.0	77.2	124.1	53.3	NO
2000.	.8285	4	20.0	20.0	5000.0	77.2	129.8	54.8	NO
2100.	.8135	4	20.0	20.0	5000.0	77.2	135.5	56.3	NO
2200.	.7976	4	20.0	20.0	5000.0	77.2	141.2	57.7	NO
2300.	.7810	4	20.0	20.0	5000.0	77.2	146.9	59.1	NO
2400.	.7641	4	20.0	20.0	5000.0	77.2	152.5	60.6	NO
2500.	.7469	4	20.0	20.0	5000.0	77.2	158.1	62.0	NO
2600.	.7297	4	20.0	20.0	5000.0	77.2	163.7	63.4	NO
2700.	.7125	4	20.0	20.0	5000.0	77.2	169.3	64.7	NO
2800.	.6955	4	20.0	20.0	5000.0	77.2	174.9	66.1	NO
2900.	.6788	4	20.0	20.0	5000.0	77.2	180.4	67.4	NO

3500.	.5852	4	20.0	20.0	5000.0	77.2	213.3	74.8	NO
4000.	.5580	5	5.0	5.0	5000.0	134.8	183.2	62.9	NO
4500.	.5739	5	5.0	5.0	5000.0	134.8	202.8	65.4	NO
5000.	.5844	5	5.0	5.0	5000.0	134.8	222.2	67.7	NO
5500.	.5905	5	5.0	5.0	5000.0	134.8	241.5	70.0	NO
6000.	.5978	5	4.0	4.0	5000.0	145.2	261.1	73.8	NO
6500.	.6021	5	4.0	4.0	5000.0	145.2	280.0	75.9	NO
7000.	.6092	5	3.0	3.0	5000.0	159.8	299.4	80.3	NO
7500.	.6141	5	3.0	3.0	5000.0	159.8	318.1	82.2	NO
8000.	.6170	5	3.0	3.0	5000.0	159.8	336.6	84.1	NO
8500.	.6226	5	2.0	2.0	5000.0	182.9	355.9	89.6	NO
9000.	.6284	5	2.0	2.0	5000.0	182.9	374.1	91.4	NO
9500.	.6329	5	2.0	2.0	5000.0	182.9	392.2	93.1	NO
10000.	.6361	5	2.0	2.0	5000.0	182.9	410.3	94.8	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

1473.	.8745	4	20.0	20.0	5000.0	77.2	99.4	46.7	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
*********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
*********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.8745	1473.	0.

```
****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****************************************************
```

APPENDIX F-2.4

HIGH EXPLOSIVES FIELD TESTS - EXPLOSION PHENOMENA AND ENVIRONMENTAL IMPACTS (DNA, October 1981)

- OD CLOUD HEIGHT -

AD/A135 737

HIGH-EXPLOSIVE FIELD TESTS - EXPLOSION PHENOMENA AND ENVIRONMENTAL IMPACTS

Kaman Tempo
Santa Barbara, CA

Oct 81

U.S. Department of Commerce
National Technical Information Service
NTIS

included in the calculations from Reference 19. There is disagreement on the significance of such conditions.

Because of the large ratio of volume to surface area for a multiton explosive charge, atmospheric oxygen may not be available to a large part of the explosive products until the temperature has decreased (because of expansion of the fireball) to where significant chemical reactions will not occur. Reference 19 states that reaction rates involving oxygen are sufficiently slow that the explosion products may be "frozen" at roughly their initial proportions as they expand and cool. In contrast, the informal opinion of Dr. Harold Ring, Assistant Director of Dupont De Nemours Research Section on explosives at Wilmington, Delaware, was that equation-of-state computations do not apply for large charges exploded in the open because virtually all of the explosion products will change to water, carbon dioxide, and nitrogen.

In either event, oxidation of the compounds shown in Table 2-4 will generally tend to change potentially hazardous compounds to less hazardous or innocuous products. Therefore, Table 2-4 can be assumed as a worst-case from the standpoint of hazardous explosion products.

CLOUD RISE AND DIFFUSION

The heat of explosion creates a buoyant fireball of hot gases and earth materials which rises rapidly until it loses buoyancy, continues to expand turbulently until it reaches stabilization dimensions, and then undergoes atmospheric diffusion as it drifts downwind. According to Church (Reference 22), explosion clouds cease to rise buoyantly within about 2 minutes after detonation, although cloud growth by turbulence may give the appearance that the cloud is still rising. Based on measurements of clouds from 22 HE charges exploded on the ground surface, Church recommends that the maximum height of the cloud at 2 minutes be calculated from the empirical relationship:

$$C_t = 508\ W^{0.25} \qquad (2\text{-}7)$$

where

C_t = cloud-top height at 2 minutes after detonation (m)

W = explosive charge TNT-equivalent weight (tons).

Based on Equation 2-7, a 500-ton event would have a cloud height of 2,400 meters. However, Equation 2-7 is based on few charges in excess of 1 ton and does not give ~~information on the cloud dimensions after turbulence ceases~~. There is evidence that the top of the cloud produced from a large explosion continues to rise after 2 minutes, either from buoyancy or from turbulence, to reach a considerably greater height.

Figure 2-16 shows the cloud-top heights from four 500-ton explosions for which cloud measurements were made. The estimated height of a 100-ton explosion cloud is also shown. As can be seen, although Equation 2-7 adequately describes cloud height 2 minutes after an explosion, cloud heights continued to increase until about 5 minutes. From this data, it appears that the maximum cloud height for a 500-ton explosion is somewhat in excess of 3,000 meters and occurs about 5 minutes after the explosion.

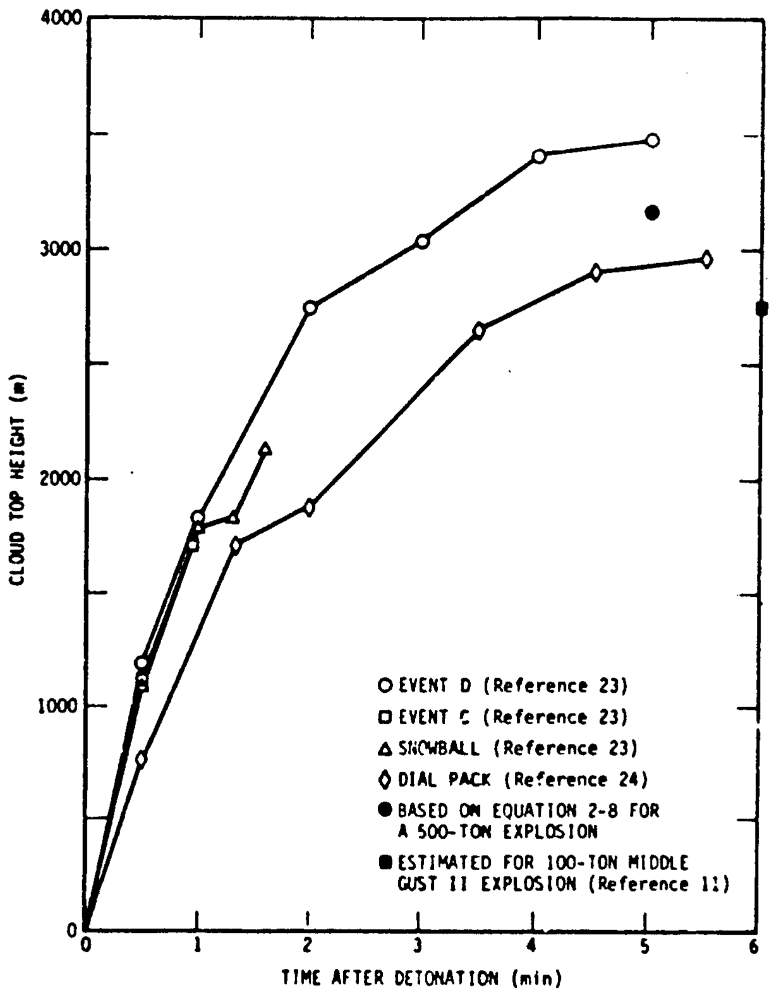


Figure 2-16. Height aboveground of large-explosion clouds.

When a cloud reaches its maximum height, it has roughly a cylindrical shape. Most clouds appear to have a bottom that is about midway between the cloud top and the ground. For example, the DIAL PACK cloud bottom was calculated to be about 1,500 meters above the ground.

Figure 2-17 shows the data for diameters of large-explosion clouds. As can be seen, the DIAL PACK cloud continued to expand, contrary to most observations in which clouds appear to contract somewhat from turbulence before diffusing. Ignoring the DIAL PACK data, the other data seem to indicate a cloud diameter of approximately 1,500 meters from a 500-ton explosion.

Based on these limited data and assuming that cloud dimensions scale by the 0.25 power of the charge weight, cloud dimensions can be estimated by the following equations:

$$C_t = \text{height to top of cloud (m)} = 670\ W^{0.25} \qquad (2\text{-}8)$$

$$C_b = \text{height to bottom of cloud (m)} = 335\ W^{0.25} \qquad (2\text{-}9)$$

$$C_c = \text{height to center of cloud (m)} = 500\ W^{0.25} \qquad (2\text{-}10)$$

$$C_d = \text{diameter of cloud (m)} = 335\ W^{0.25} \qquad (2\text{-}11)$$

$$C_v = \text{volume of cloud } (m^3) = 3 \times 10^7\ W^{0.75} \qquad (2\text{-}12)$$

The cloud-top height and diameter based on Equations 2-8 and 2-11 for a 500-ton explosion are plotted on Figures 2-16 and 2-17, respectively, for comparison with the data. For 1-ton explosions, Equations 2-8 and 2-11 give a cloud-top height of 670 meters and a cloud diameter of 335 meters, which is roughly compatible with data on charges of this size from References 25 and 26. These references also indicate that charges must be considerably buried before cloud sizes are significantly affected.

Cloud measurements have also been reported for MISERS BLUFF II-1, a 100-ton event, and II-2, six 100-ton closely-spaced charges that were detonated simultaneously (Reference 27). These data, shown in Figures 2-18 and 2-19, are of considerable interest. The MISERS BLUFF II-1 cloud shows the classic behavior of a cloud during its stabilization phase when the cloud size is relatively unchanged until turbulence ceases and the cloud diffuses with the winds. The MISERS BLUFF II-2 cloud shows vertical stabilization but continual growth in width, which may be due to the interaction of multiple clouds or to strong winds. (The cloud tracking data indicate the cloud was moving downwind at 25 to 30 mph during the observation period.)

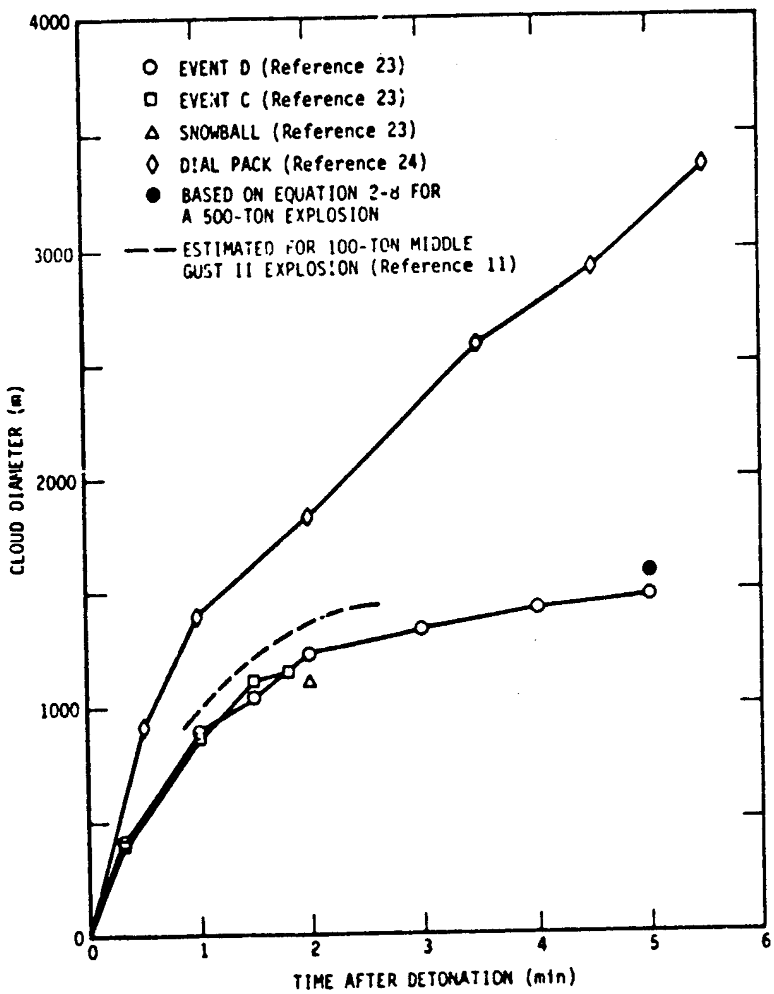


Figure 2-17. Diameters of large-explosion clouds.

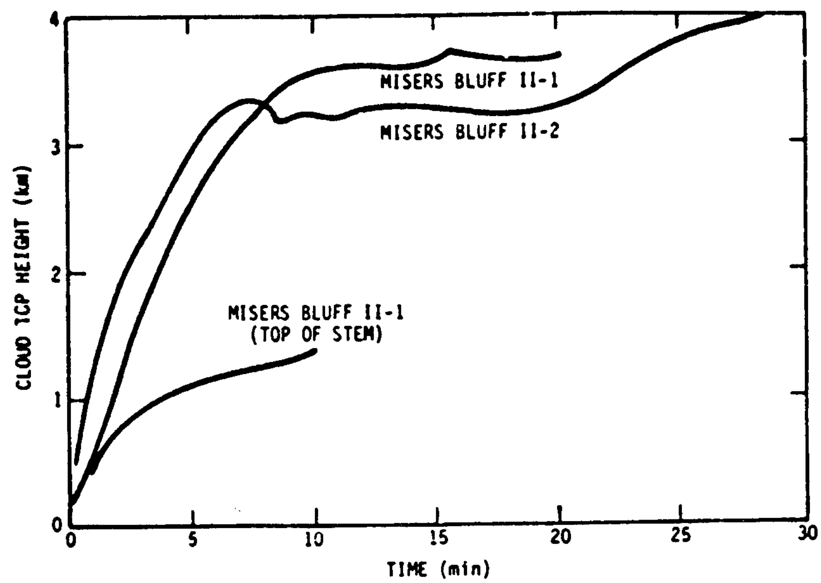


Figure 2-18. Top of MISERS BLUFF clouds. (Source: Reference 27)

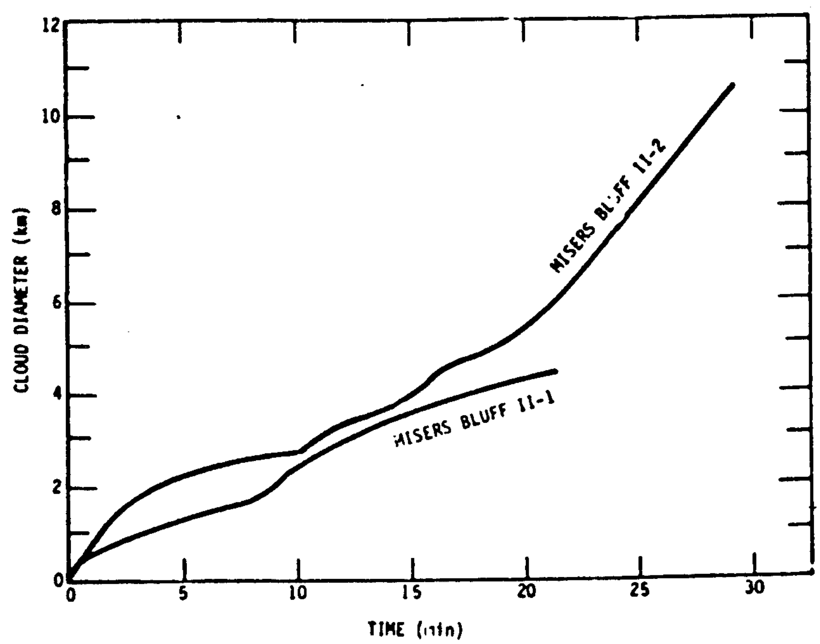


Figure 2-19. Diameter of MISERS BLUFF clouds. (Source: Reference 27)

The cloud dimensions during the first 6 minutes are in good agreement with the other data clouds in Figures 2-16 and 2-17 and with Equations 2-8 through 2-12. The measurements of the bottom of the MISERS BLUFF II-2 cloud (the stem height) support the previous observations that the bottom of a cloud is about midway between the top of the cloud and the ground. Note, however, that the MISERS BLUFF observations were carried out over a longer time period than for the previous field tests, and they indicate that maximum cloud size at stabilization occurs later than 5 minutes after the explosion. This indicates that Equations 2-8 through 2-12 may underestimate the size of an explosion cloud at stabilization. For the purposes of environmental analysis, however, underestimation of an explosion cloud is conservative because a larger cloud is necessarily more diffuse and the concentrations of gaseous detonation products and dust at ground level downwind would be less than for a smaller cloud size at stabilization. Therefore, Equations 2-8 through 2-12 are still recommended for the purposes of environmental analysis, until more cloud measurements from other large-scale field tests are available to better estimate stabilized cloud dimensions.

Most of the earth materials from a crater fall back to earth in the vicinity of the crater. The earth materials in a stabilized cloud are relatively fine particles that can be transported downwind with the gaseous detonation products. Dust samples taken from the DIAL PACK cloud by aircraft fly-throughs showed that the average dust concentration at the time the cloud stabilized (approximately 15 minutes after the explosion) was approximately 4 mg/m^3 and the concentration decreased inversely with time to the 1.4 power over the measurement period of from 10 to 60 minutes following the explosion; that is, for each ten-fold increase in time, the dust concentration decreased by a factor of 25 (Reference 28). Based on the approximate cloud dimensions at 5 minutes of a vertical thickness of 1,500 meters and a horizontal diameter of about 3,100 meters and the apparent crater volume of 7,400 m^3, approximately 2 percent of the crater volume was in the DIAL PACK explosion cloud at the time of cloud stabilization.

The more extensive sampling and analysis of the dust clouds from MISERS BLUFF II-1 and II-2 events (Reference 29) indicate much higher concentrations than the data from DIAL PACK. Figures 2-20 and 2-21 show the cloud dimensions and concentrations from the MISERS BLUFF events at 10 and 20 minutes after the detonations, as reconstructed from the extensive data. These dust concentrations are one to two orders of magnitude greater than the concentration of the DIAL PACK cloud. The total mass of dust in the II-1 cloud 10 to 20 minutes after detonation is reconstructed to be approximately 8×10^8 grams (880 tons), which indicates approximately one-third of the crater volume of 150 m^3 was in the stabilized explosion cloud. The total mass in the multiburst II-2 cloud 10 to 20 minutes after detonation was reconstructed to be approximately 5×10^9 grams, which also indicates approximately one-third of the crater volume of 10,600 m^3 was in the stabilized explosion cloud.

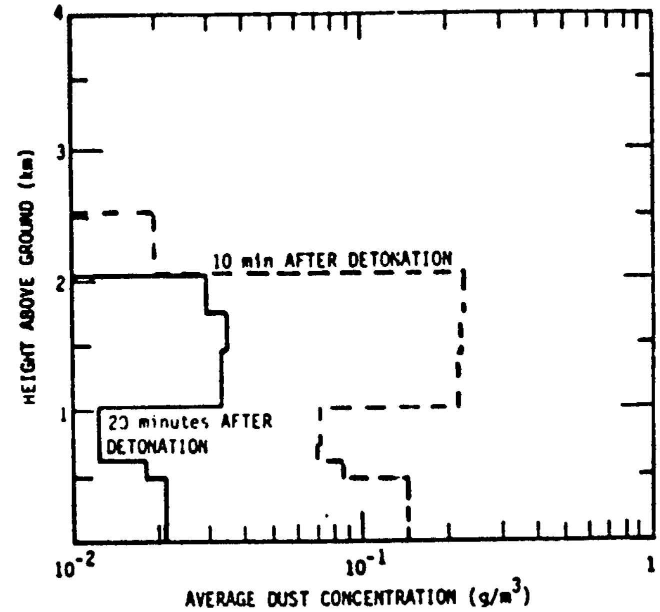


Figure 2-20. Reconstructed MISERS BLUFF II-1 dust cloud. (Source: Reference 29)

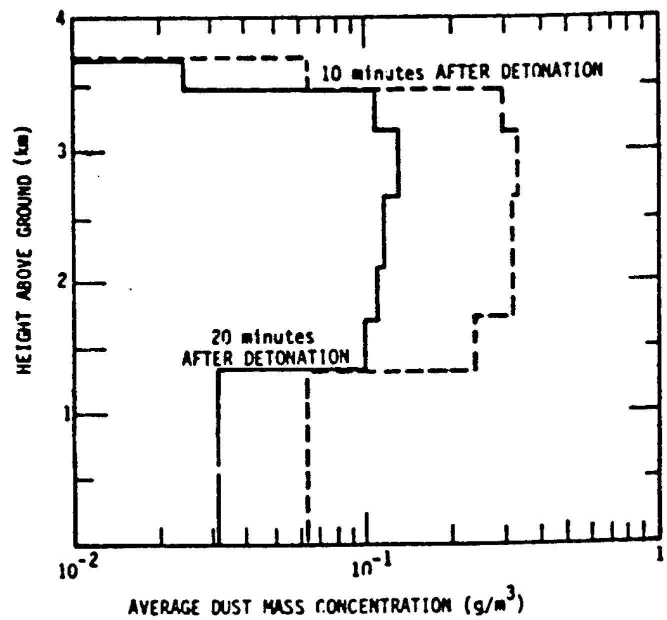


Figure 2-21. Reconstructed MISERS BLUFF II-2 (multiburst) dust cloud. (Source: Reference 29)

The sampling data from the individual aircraft sampling passes through the cloud and the cloud reconstruction indicate that, although the concentrations varied at different points in the cloud, there was no indication of the concentrations being greater at the center of the cloud. It can be assumed that the dust mass is distributed evenly throughout the cloud at the time of stabilization.

Since the recent MISERS BLUFF data are based on an extensive experimental program and are more conservative from an environmental impact standpoint than the DIAL PACK results, the results from MISERS BLUFF will be assumed in this analysis, i.e., it is assumed that one-third of the apparent crater contents will be distributed evenly throughout an explosion cloud and available for distant transport downwind as the cloud diffuses. Cloud sampling in future field tests may clarify the considerable disparity between the MISERS BLUFF and DIAL PACK data.

As an explosion cloud drifts downwind, it diffuses and the concentrations of dust and explosive products decrease while the edge of the cloud approaches ground level. At a certain distance downwind, which is a function of the initial height and dimensions of the cloud, the rates of diffusion in the horizontal and vertical directions, and wind speed, the exposure at ground level from this cloud will reach a maximum; at closer distances, the cloud has not diffused to ground level and at greater distances, the horizontal diffusion dominates to reduce the exposure below the maximum. The estimated exposure at ground level directly downwind from an explosion cloud can be calculated from Equation 2-13 which has been adapted from Reference 30:

$$E = \frac{\sigma_{XI}\,\sigma_{YI}\,\sigma_{ZI}}{\sigma_{XI}\,\sigma_{YI}\,\sigma_{ZI} + V_I} \times \frac{Q}{\pi\,\sigma_{YI}\,\sigma_{ZI}\,\bar{u}} \exp\left\{\frac{-h^2}{2\,\sigma_{ZI}^2}\right\} \qquad (2\text{-}13)$$

where

E = exposure ($g \cdot sec/m^3$)

σ_{XI} = standard deviation of the distribution of material in the cloud in the horizontal downwind direction (m)

σ_{YI} = standard deviation of the distribution of material in the cloud in the horizontal crosswind direction (m)

σ_{ZI} = standard deviation of the distribution of material in the cloud in the vertical direction (m)

APPENDIX F-2.5

CLOUD RISE FROM HIGH EXPLOSIVES DETONATIONS

(Church, May 1969)

TID-4500 (53rd Ed.)
UC-41, Health and Safety

SC-RR-68-903

CLOUD RISE FROM HIGH-EXPLOSIVES DETONATIONS

H. W. Church, 9511
Sandia Laboratories, Albuquerque

May 1969

ABSTRACT

Data from a series of high-explosives trials of debris product cloud top heights versus time are presented. A brief comparison with some other experiments and with theory is made. It is concluded that so-called stabilization height can be predicted best as a function of explosive yield to the 0.25 power for chemical explosives in average atmospheres.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

CLOUD RISE FROM HIGH-EXPLOSIVES DETONATIONS

Introduction

For the problem of predicting atmospheric pollutant dispersal from contaminant sources in the atmosphere, knowledge of the initial conditions is required before a reasonable description of the dilution processes can be attempted. These conditions are: (1) contaminant source strength, (2) source characteristic, (3) characteristic dimensions, and (4) meteorological conditions which determine transport and diffusivity. The characteristics under Item 2 needing definition are type, geometry, location, and time. Type includes phase, whether gaseous or particulate. Geometry defines whether the source issues from a point, along a line, or over an area. Location, besides defining relative horizontal position to possible receptors also specifies the height of release. Time character specifies the rate of release whether continuously or instantaneously resulting in what is frequently referred to as "plume" or "puff," respectively.

The continuing concern over the safety of transport and storage operations of nuclear weapons has led Sandia Laboratories and others to develop prediction capabilities especially designed for the application to puffs released near ground level. While an accident involving nuclear weapons has an essentially zero probability of causing a nuclear detonation, there is a possibility of causing the chemical explosive components to explode and disperse the nuclear fuel. Such explosions may occur because of weapon exposure to fire or impact. This type of weapon accident was simulated in a field experiment called Operation Roller Coaster in Nevada in 1963.

As a result of joint US-UK effort on this operation, a model for the computation of aerosol transport and diffusion in the atmosphere was developed.[1] A principal input to this model is the top height of the explosively produced aerosol cloud. It is this characteristic dimension that is the main subject of this report.

In treating the problem of predicting cloud height, this report contains a brief discussion on background and theory of detonation cloud rise prediction, followed by a description of some cloud height measurements made in conjunction with Project Roller Coaster, together with some results and conclusions.

Background

The study of the rise of continuous plumes, especially from stacks, has received a great deal of attention. In fact, as stated in Reference 2, at least 20 different formulas have been published since 1950, none of which is universally accepted. The rise of puffs seems to be in a similar state of uncertainty since the only basic differences between plumes and puffs are time scales and the number of dimensions, two and three, respectively, available for their expansion.

BLANK PAGE

A puff rises in the atmosphere primarily because of its buoyancy and initial momentum. The rising puff's motion relative to the ambient air causes turbulent mixing which results in a net entrainment of nonbuoyant air. As the puff decelerates because of decreasing buoyancy, the turbulence at the puff boundary decreases to the value found in the ambient air. When the buoyant force decreases to zero, cloud growth will continue at a rate determined by the ambient turbulence. Thus, beyond several minutes apparent rise of the puff top is simply a continued turbulent expansion. The rate at which buoyancy approaches zero is a function both of entrainment rate and ambient temperature lapse rate or static stability.

Various theories have been advanced which attempt to describe the behavior of convective elements in the atmosphere. The one which seems most appropriate to the present problem is that given by Morton, Taylor, and Turner.[3] In that work the point source is described by the total buoyant force imparted to a large volume of entrained air divided by the density of air. It was found theoretically by dimensional arguments that the height of rise was proportional to the quarter power of initial buoyant force divided by the quarter power of ambient stability. Since the proportionality constant could not be determined from dimensional analysis alone, it was necessary to appeal to experimental data.

Based on some experiments carried out in a stably stratified salt solution where known volumes of a light fluid were released, a regression equation $H = 2.66\,F^{1/4}\,G^{-1/4}$ was determined for cloud top height. The quantity F is buoyancy and G is degree of stratification. In the atmosphere, $F = gQ/C_p\rho T$, and

$$G = (g/T)\partial\theta/\partial Z$$

where g is acceleration of gravity, Q is energy released, C_p is specific heat of air at constant pressure, ρ is air density, T is air temperature, θ is potential temperature, and Z is height. For a standard atmosphere where $C_p = 1.004 \times 10^3$ (kjoules/°K ton), $\rho = 1.225 \times 10^{-3}$ (ton/m^3), where 1 ton = 10^3 kg, and $\partial\theta/\partial z = 3.3 \times 10^{-3}$ (°K/m) or temperature lapse rate of -6.5°C/km, the regression equation reduces to $H = 1.87Q^{1/4}$.

Morton, et al, gave an example of this equation's application to the case of exploding TNT using an energy conversion factor of 1.7×10^3 kjoules per pound of TNT. This gives, W in pounds TNT:

$$H = 67.4\ W^{1/4}\text{, for H in meters}$$

$$H = 221\ W^{1/4}\text{, for H in feet, or}$$

$$H = 700\left(\frac{W}{100}\right)^{1/4}.$$

For the more widely used energy conversion factor of 2.1×10^3 kjoules per pound TNT[4] the coefficient 67.4 above changes to 71.0; on the other hand the 67.4 could be retained by taking a slightly more stable lapse rate of -5.7°C/km for an "average" atmosphere.

Least square fit to data from nuclear explosion clouds in the troposphere suggest an exponent on equivalent explosive weight of about 0.3. Some UK AWRE data on small charges (6 to 5000 pounds) suggested (D. M. C. Thomas, unpublished note) an exponent of 1/3. A dimensional argument by Briggs[2] suggests an exponent of 1/2. Thus, it is apparent that there is considerable uncertainty as to the proper regression formula to use. Therefore, in this report least squares fit of cloud top height versus explosive yield is done for the 4 Roller Coaster shots, 19 TNT shots, and for 74 nuclear shots which have been announced in the open literature[4,5] for yields of 21 kt or less.

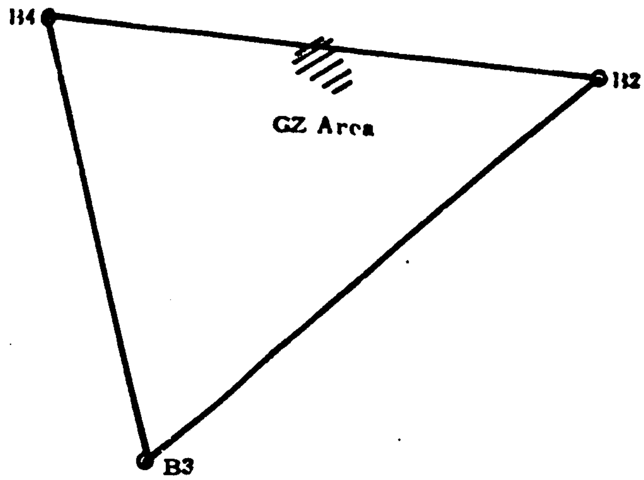
Procedure

During Project Roller Coaster, a photographic technique was developed[6] which allowed observation of cloud top height information to be made at night. It turned out that with reasonable wind conditions (<6 m/sec) clear photographic images could be obtained using the flare illumination technique to about 5 minutes after detonation in most instances. In order to obtain more data on cloud rise from TNT detonations, a series of 13 shots was run one night in June from 5 p.m. to 6 a.m. In addition, an earlier preliminary series was run in April.

Blocks of TNT whose total weight ranged from 140 to 2800 pounds, were stacked in roughly cubical shapes on the dry lake bed of Cactus Flat or Stonewall Flat in south central Nevada. For the June series, three locations previously surveyed to first order were equipped with K-18 cameras and weather balloon[4] tracking theodolites. The observer locations identified as B2, B3, and B4 formed an acute triangle, shown in Figure 1, whose longest side was about 6-1/2 km in length. The detonation area (GZ) was located within the triangle as shown in the figure. The first four of the six April preliminary HE shots were observed with one pair of double theodolites arranged as shown in Figure 2. These shots were done within 2-1/2 hours after sunrise on a clear calm morning in a very stable ground-based layer which was rapidly losing stability as the sun rose. The last two preliminary shots were done in the general area of Figure 1 in somewhat windier weather. The last preliminary shot was placed in a trench covered with a dirt roof about 2-1/2 meters deep but open on one end. The puff shot out the open end of the trench such that the dirt cover had little influence on its total rise and hence probably behaved similarly to the other surface shots.

As done for the Roller Coaster events themselves,[6] observation synchronization was achieved by transmission of radio tones to each observation point and to the flare launcher near GZ. The tones activated the camera film transport mechanism and/or signaled the theodolite crew to read their elevation and azimuth angles. Theodolite operators were instructed to track the cloud top. Observations were taken at 30 seconds and at each whole minute up to 5 after detonation. Table I lists the 13 HE shots, the 4 Roller Coaster shots, and the 6 useful preliminary shots with their time of detonation, explosive weight, and method of observation.

Routine supporting meteorological temperature and wind profile data were taken for the June series and for Roller Coaster.[7] Experimental temperature profiles were obtained for the preliminary series (see Reference 7, p. 24, for measurement systems description; see Appendix for data). Table I summarizes the temperature and wind data from ground to 2-minute cloud top height. The definition of stability S is given in the following section.

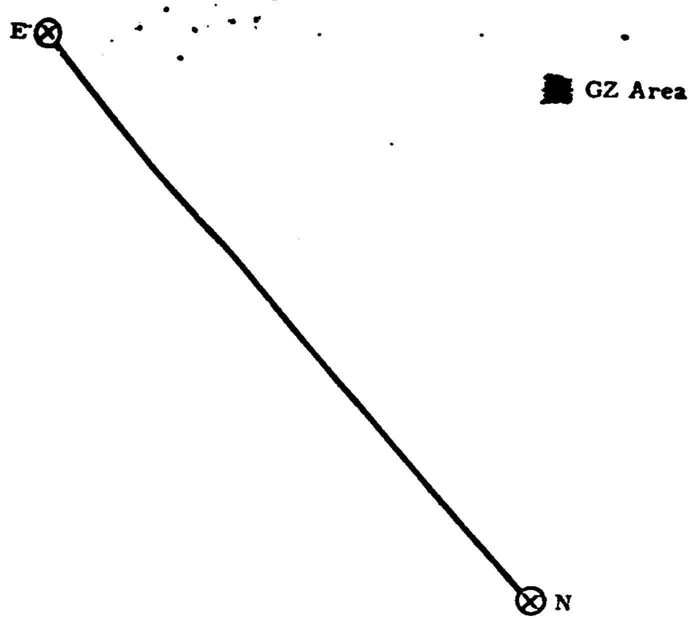


Elevation, Meters Above MSL	
GZ	1636
B2	1642
B3	1695
B4	1665

Baseline, Horizontal Length, Meters	
B2-B3	6521
B3-B4	4975
B4-B2	6136

Azimuth of baseline B4 to B2 = 98 degrees east of North.

Figure 1. Geometry of Ground Zero and Observer Points for the June Series of HE Shots



Elevation, Meters Above MSL	
GZ	1494
E	1502
N	1512

Baseline, Horizontal Length, Meters	
E-N	1302

Figure 2. Geometry of Ground Zero and Observer Points for the April Preliminary Series of HE Shots

Other explosives experiments were sought in the literature in an attempt to obtain data for a wider range of explosive sizes. Reference 8 contained some information on high-explosives tests conducted in Utah and Nevada in 1951. However, these shots were partially buried and no temperature profile data were given with the reported cloud heights. Thus, these data were not used in the present analysis.

Some information was obtained on cloud height data versus time for some 500-ton TNT shots (one in Canada, two in Hawaii) which provided very useful information on large size TNT shots. All of these data will be discussed together in the following section.

TABLE I

Summary of Explosives Experiments, Cloud Measurement Method, and Meteorological Measurements

Shot No.	Date (1963)	Time (PDT)	TNT Yield (lb)	Method*	Stability (S**)	Mean Wind Speed (m/sec)
1	4 June	1720	140	C, T	-0.49	10
2	4 June	1753	140	C, T	-0.40	10
3	4 June	1818	140	C, T	-0.47	11
4	4 June	2150	1600	C	+0.86	5
5	4 June	2248	140	C	+1.55	3
6	4 June	2318	560	C	+1.03	2
7	4 June	2340	140	C	+1.36	1.5
8	5 June	0304	1600	C	+1.36	2
9	5 June	0335	140	C	+2.49	3
10	5 June	0404	420	C	+1.96	2
11	5 June	0428	140	C	+1.73	5
12	5 June	0517	140	T	+0.26	7
13	5 June	0549	560	T	+0.27	6.5
Double Tracks	15 May	0255	118	C	+1.07	8
Clean Slate - 1	25 May	0416	1062	C	+0.97	7
Clean Slate - 2	31 May	0347	2242	C	+1.28	4
Clean Slate - 3	9 June	0330	2242	C	+1.53	2.5
P3	10 April	0535	140	T	+7.07	--
P4	10 April	0613	140	T	+1.59	--
P5	10 April	0648	140	T	+0.49	--
P6	10 April	0730	140	T	-0.29	--
P7	16 April	0602	1400	T	(+1.90)	--
P8	18 April	0514	2800	T	(+1.56)	--

*C - Camera
T - Theodolite

**$S = 1 - \gamma/\Gamma$

+1.24 5.5

Results and Discussion

A tabulation of each shot with observed cloud top height versus time by observation method is shown in Table II. Only three shots provided duplicate measurement between camera and theodolite. Only the first five preliminary shots did not have more than one pair of double theodolites (or cameras).

Because of irregularly shaped puffs, less than optimum lighting conditions, and some high winds, the data are believed to be reliable to within ±15 to 20 percent. Camera data were reduced by conventional photo optical techniques while double theodolite data (June series) were reduced with a computerized version of a vector technique described by Thyer.[9] In general, table entries are averages of the estimates from the three pairs possible.

From the table it can be seen that heights still are increasing at the last observation time (with four exceptions). In general, the buoyant motion of the puffs as a whole had ceased by 2 minutes after detonation. The continuing rise of the top after this time was apparently caused by continuing turbulent growth which caused the whole puff to expand as it was carried downwind.

Stability values and mean wind speeds are shown in Table I as derived from the supporting meteorological data shown in the Appendix. Stability is defined by

$$S = 1 - \gamma/\Gamma ,$$

where γ is the average ambient temperature lapse rate from ground to 2-minute cloud top height, and Γ is the dry adiabatic lapse rate (-9.8°C/km). Wind speeds are averaged over the cloud height.

It was decided to perform a least-squares fit of all cloud heights using the expression of Morton, et al, in order to compare height to yield for average lapse rates. The expression fitted was

$$H = KW^{P} ,$$

where the coefficient K was to be determined either with the exponent P fixed at 1/4 or allowed to vary in order to minimize the squares of the differences between logarithms of observed H (at 2 minutes) and those calculated by the best fit relation. Various combinations of observation data were used in order to determine any systematic differences in the various experiments.

For comparison purposes cloud height data from 74 nuclear explosive tests ranging in yield from 400 pounds to 21 kilotons TNT equivalent were taken from References 4 and 5. Since clouds of yield greater than about 21 kt enter the stratosphere, a region of much greater stability than the troposphere, these yields were excluded in order to study only the region of average lapse rates. These data vary considerably in quality but are included because they provide some information about the higher yield ranges. A bias in the nuclear data may appear for two principal reasons. The first is that reported cloud top heights may be for times greater than 2 minutes after detonation.

TABLE II

Cloud Top Heights (Meters) Versus Time (Minutes)

Time (min)	Shot 1		Shot 2		Shot 3		Shot 4	Shot 5	Shot 6	Shot 7	Shot 8	Shot 9	Shot 10	Shot 11	Shot 12	Shot 13
	Cam	Theod	Cam	Theod	Cam	Theod	Cam	Cam	Cam	Cam	Cam	Cam	Cam	Cam	Theod	Theod
1/2	127	126	111	87	123	111	293	120	147	--	212	122	152	135	155	196
1	225	263	152	143	193	204	385	175	225	197	316	189	219	176	237	291
2	--	397	232	208	345	333	498	257	377	271	450	193	286	283	302	382
3	--	553	--	270	--	343	584	320	458	327	552	189	319	374	478	461
4	--	978	--	266	--	488	--	--	--	--	--	--	--	--	524	557
5	--	--	--	--	--	592	598	419	667	369	680	205	324	--	583	618

Time (min)	Double Tracks*	Clean Slate - 1*	Clean Slate - 2*	Clean Slate - 3*	Shot P3	Shot P4	Shot P5	Shot P6	Shot P7	Shot P8
	Cam	Cam	Cam	Cam	Theod	Theod	Theod	Theod	Theod	Theod
1/2	118	249	242	262	47	64	88	105	251	358
1	164	378	298	377	84	142	142	168	380	432
2	210	558	415	494	76	180	207	180	565	536
3	216 (2-1/2 min)	643 (2-2/3 min)	440	520	--	--	271	--	668	646
4	--	--	428	510	--	--	--	--	759	695
5	--	--	412	--	--	--	--	--	832	740

*Data from Reference 6.

Nuclear clouds are generally thought to "stabilize" some 4 to 6 minutes after detonation in contrast to the 2 to 3 minutes observed for HE. The second reason, which may be the basis for the first, is that it is thought that the much hotter nuclear fireball rises more as a bubble during its early phase because of the extreme density difference between it and the air. Thus, relatively little mixing occurs during about the first minute compared to the case for a turbulent thermal with its attendant turbulent entrainment.

Table III shows the results of the regression analyses, using various combinations of the data. Figure 3 is a plot showing all the data compared to the theoretical results of Morton, et al, along with four of the significant curves of the regression analyses from Table III.

TABLE III

Results of Regression Analyses of Cloud Height (H in Meters)
Versus Yield (W in Pounds TNT)
(Expression fitted is ln H = ln K + P ln W.
$\sigma_g(H)$ is the geometric standard deviation of H.)

Data Combinations	P*	K	$\sigma_g(H)$
Morton, et al, stratified salt solution	1/4	71.0	--
4 RC only	1/4	72.1	1.206
	0.267	60.6	1.205
4 RC, 13 HE	1/4	77.8	1.227
4 RC, 13 HE, 6 PHE	1/4	72.1	1.383
	0.283	59.4	1.380
4 RC, 13 HE, 5 PHE	1/4	76.1	1.232
	0.245	78.2	1.232
74 NE only	1/4	114	1.338
	0.292	61.8	1.302
74 NE, 4 RC, 13 HE	1/4	106	1.370
	0.292	61.6	1.292
74 NE, 4 RC, 13 HE, 5 PHE, 2-500 T	1/4	103	1.382
	0.293	59.4	1.294

RC = Roller Coaster
HE = high explosive
PHE = preliminary high explosive
NE = nuclear explosive
500 T = 10^6 lb of TNT shots.

*Where P is entered as 1/4, this value was fixed and a least-squares fit to K was obtained. Where a decimal format is entered a simultaneous best fit to both P and K was obtained.

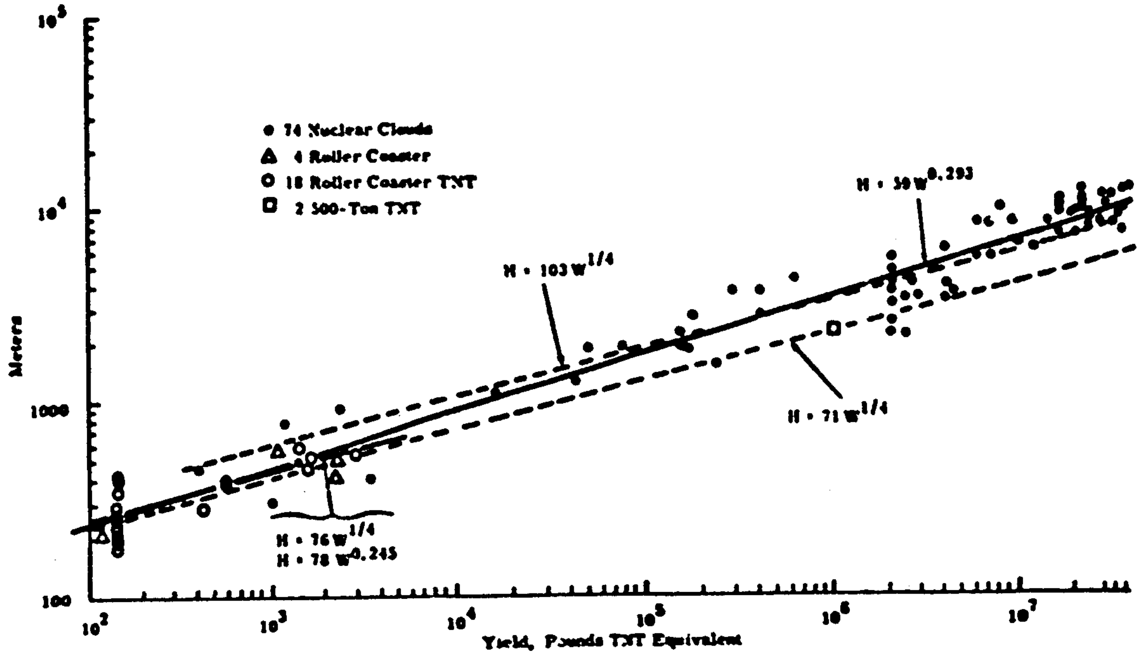


Figure 3. Two-Minute Cloud Top Height Versus Yield

Of all the shots used, only one was fired in a sufficiently nonaverage atmosphère to justify its exclusion. That was the first usable preliminary HE shot, P3. From Figure 3 it can be seen that its height was about a factor of four below the average whereas none of the others was more than a factor of two from the average. A look at the stabilities shown in Table I shows that the stability for shot P3 was almost three times that of the next closest value of 2.5 for Shot 9. All the other stabilities range from -0.5 to 2.5. Figure 4 is a plot of the difference of logarithms of observed height to calculated height versus stability as defined previously. Also shown in Figure 4 is a plot of ln $(H_i/H_{calc}) = S^{-1/4}$ which represents the character of the stratification dependence in the theory of Morton, et al. It is seen from the data plot on this figure that there is a definite inverse correlation between cloud height and stability, but not necessarily along the $S^{-1/4}$ curve.

There are several problems associated with attempting to correlate cloud height with atmospheric stability. Probably the most important is definition and measurement of stability. The lapse rate γ was defined as the average (uniform) lapse rate from ground to cloud top. It is well known that typical temperature profiles in stable conditions are seldom linear especially in the boundary layer (<1 km). Detailed temperature measurement was difficult both with the usual rugged radiosonde and with the special balloon suspended string of aspirated thermisters supplied by the UK during Roller Coaster. Therefore, the values of stability given can be used only as a general comparative guide among the various shots.

Another problem worthy of mention when comparing cloud heights from various explosives is that of conversion to a standard explosive energy equivalent, usually pounds of TNT. Frequently conversion is based on equivalent blast output from one type of explosive to another. However, for

the present problem it is the thermal output which determines the initial buoyancy that lifts the puff. If it is assumed that the energy of explosion or detonation is partitioned similarly between radiation, blast, and residual heat content of explosive products, then it is possible to convert from one explosive to another by the ratio of the given heats of explosion. The equivalent TNT yields shown in Table I for the four Roller Coaster events were converted using the heat of explosion for each explosive and relating it to that for TNT (1080 cal/g).

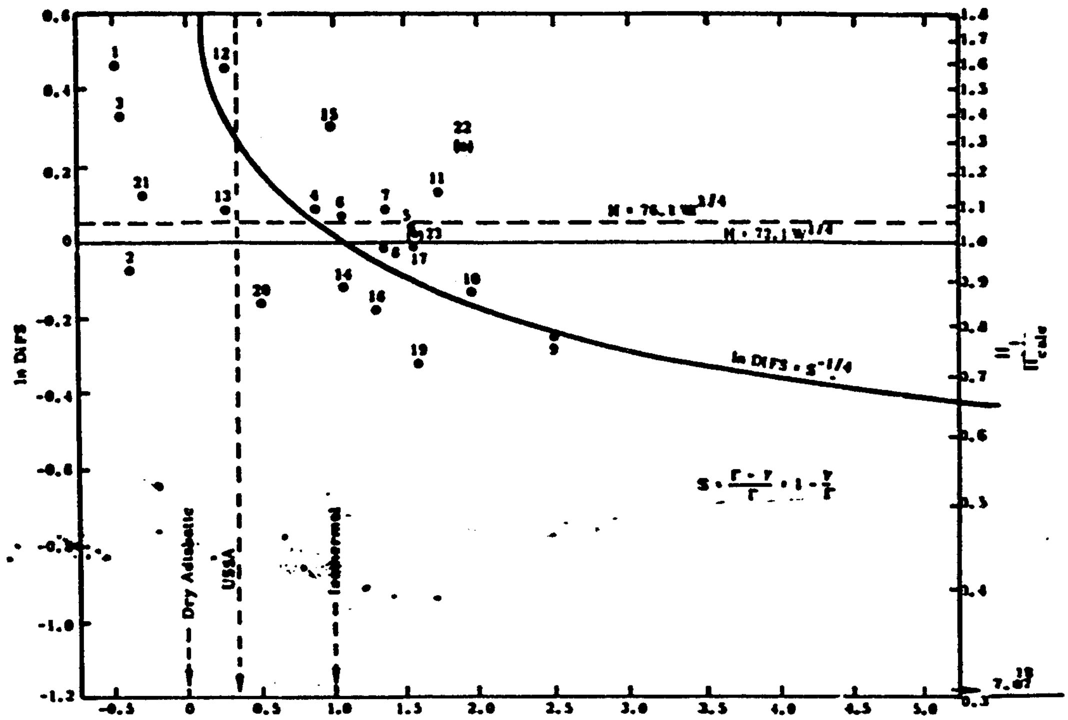


Figure 4. Calculated Versus Observed Heights Versus Stability

Conclusion

As shown in Figure 3 and Table III the agreement between the high-explosive cloud data and the theory proposed by Morton, et al, is quite satisfactory. Only a slight difference exists between the coefficient determined in salt water of 71 and the value of 76 determined from the 22 events measured in the atmosphere. The geometric standard deviation of the heights for these 22 experiments, 1.23, also is quite acceptable considering measurement uncertainties of cloud top height and atmospheric stability. It is interesting to note that the two 500-ton TNT shots each with 2-minute height of 2300 meters is within 10 percent of the best fit curve which was fit to data covering yield range of only 118 to 2800 pounds.

Therefore, it is recommended that for estimating so-called stabilized cloud top heights from explosive sources that K = 76 and P = 1/4 be used. Estimates of cloud height using these values should be within about 20 percent for the stability range $-\frac{1}{2}$ to $+2\frac{1}{2}$ found in average lapse rates.

APPENDIX

METEOROLOGICAL DATA

The following figures show profiles of temperature, wind speed, and wind direction to heights of 600 meters above ground where available. Recording cup and vane anemometers were used at 9 meters above ground with some at 18 and 37 meters in addition. Higher level winds were obtained by radar tracking of slow rising (~2 m/sec) balloons. Temperatures were obtained from modified radiosonde systems with some profile data to 300 meters obtained from tethered balloon-borne, aspirated thermisters. For further details of measurement systems see Reference 7.

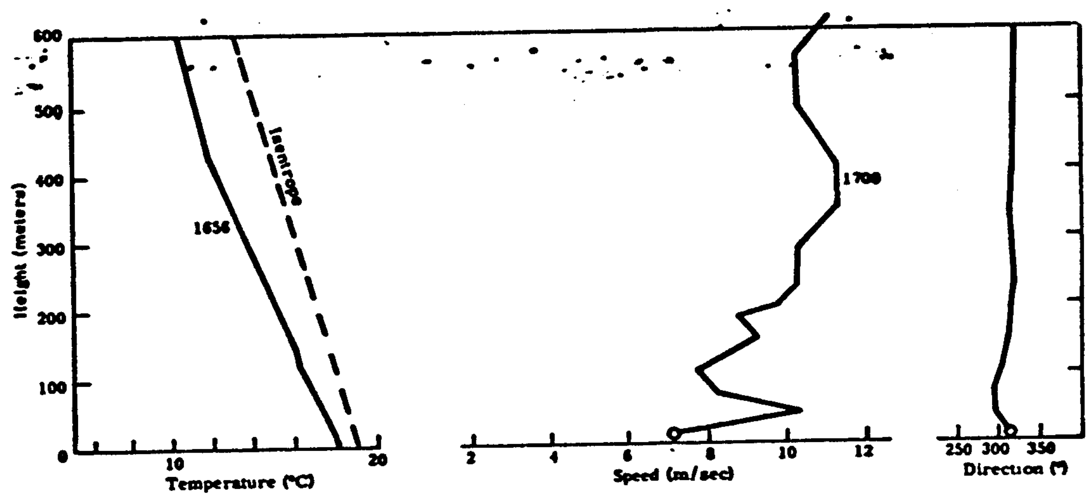


Figure A-1. HE Shot No. 1, 1720 PDT, 140 Pounds

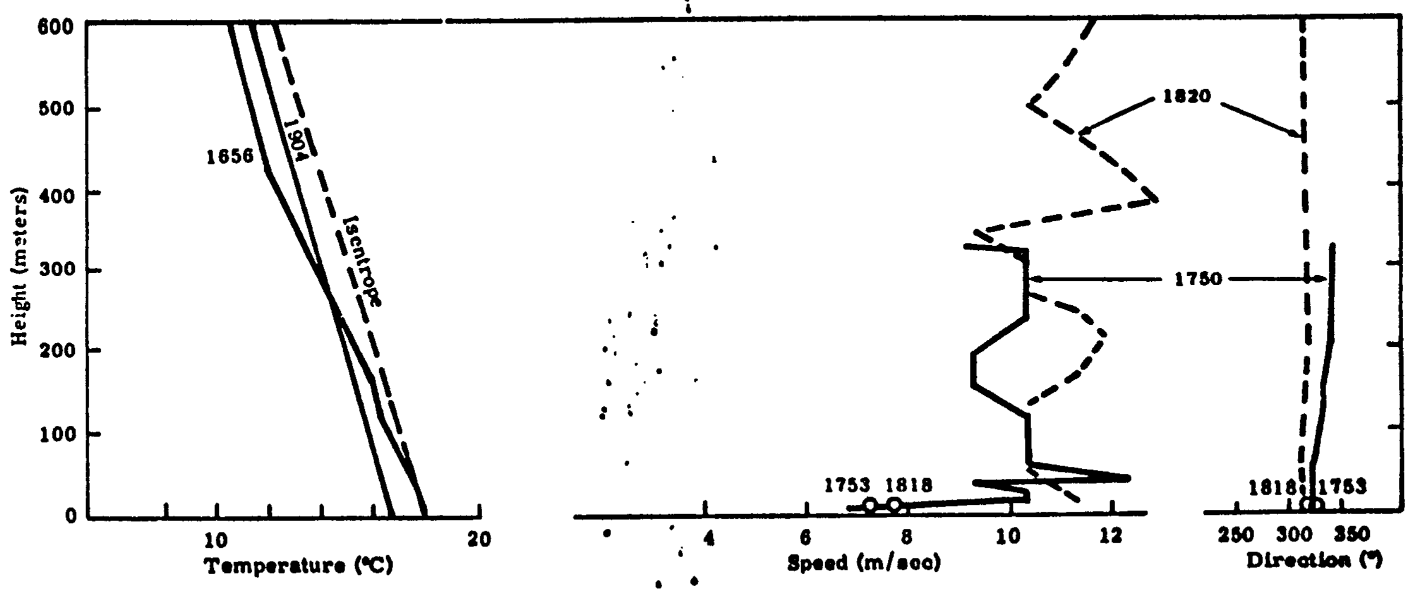


Figure A-2. HE Shot No. 2, 1753 PDT, 140 Pounds;
HE Shot No. 3, 1818 PDT, 140 Pounds

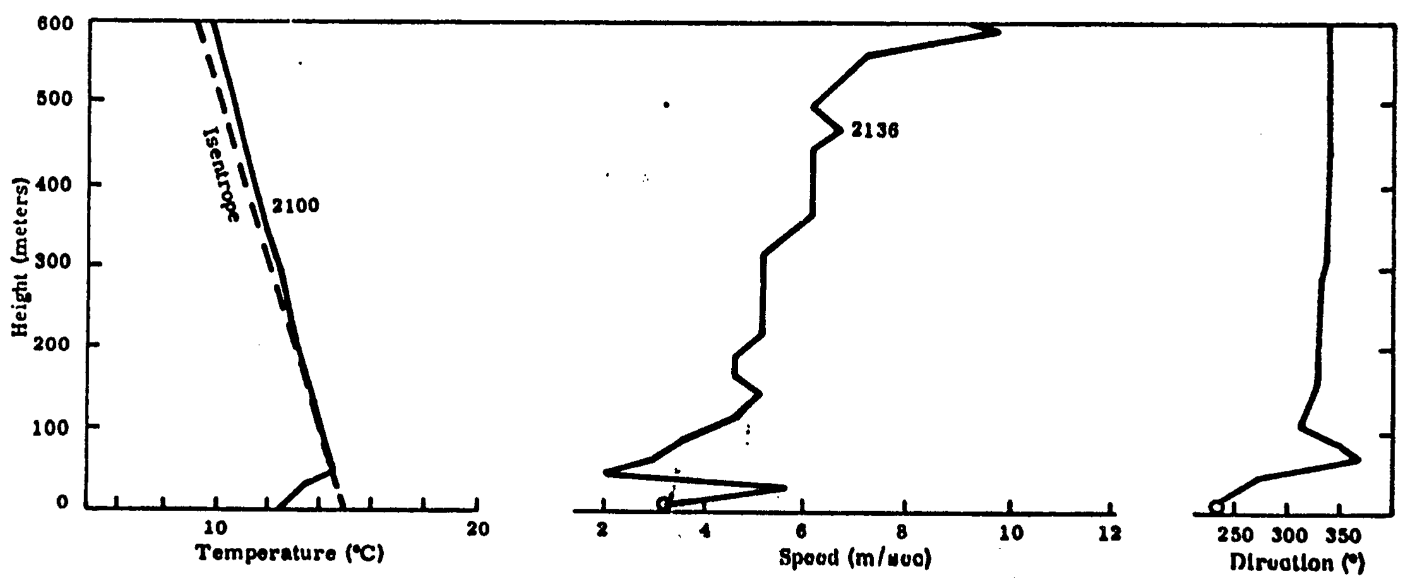


Figure A-3. HE Shot No. 4, 2150 PDT, 1600 Pounds

[redacted]

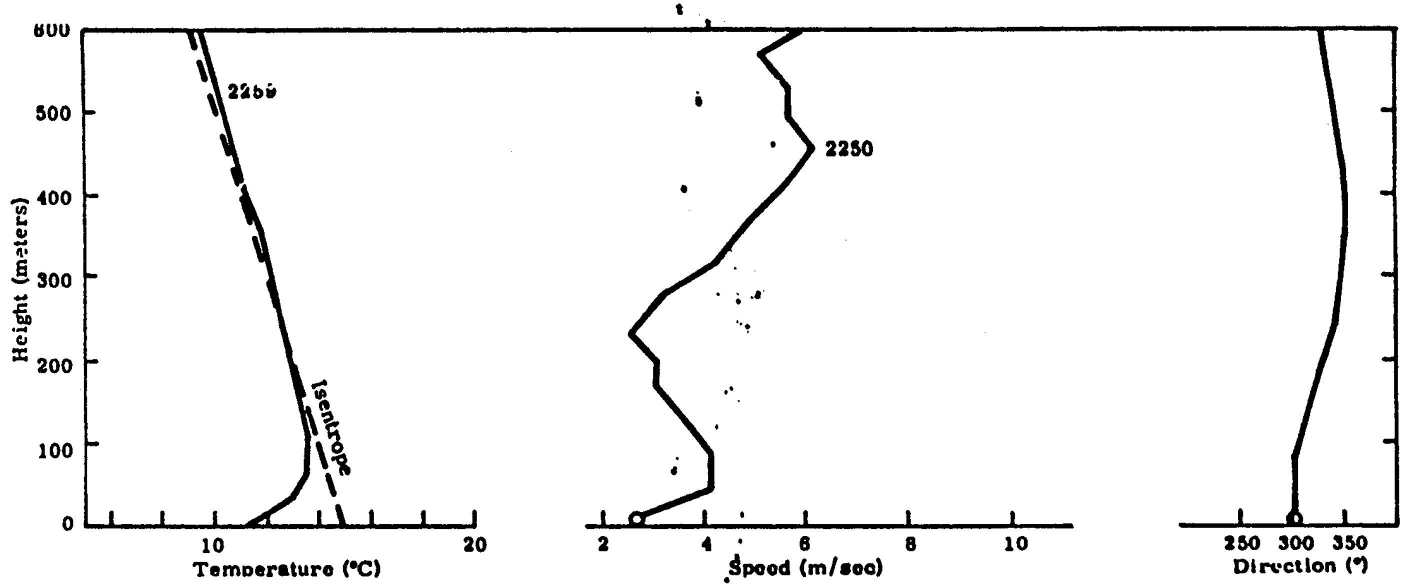


Figure A-4. HE Shot No. 5, 2248 PDT, 140 Pounds

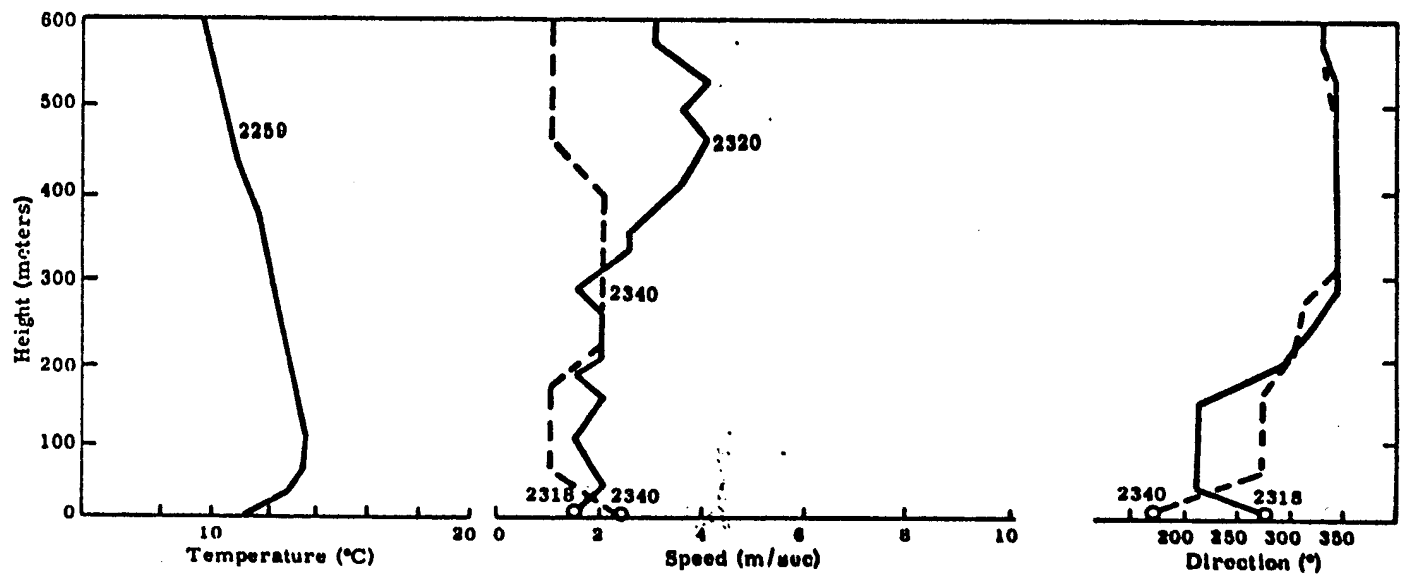


Figure A-5. HE Shot No. 6, 2318 PDT, 560 Pounds;
HE Shot No. 7, 2340 PDT, 140 Pounds

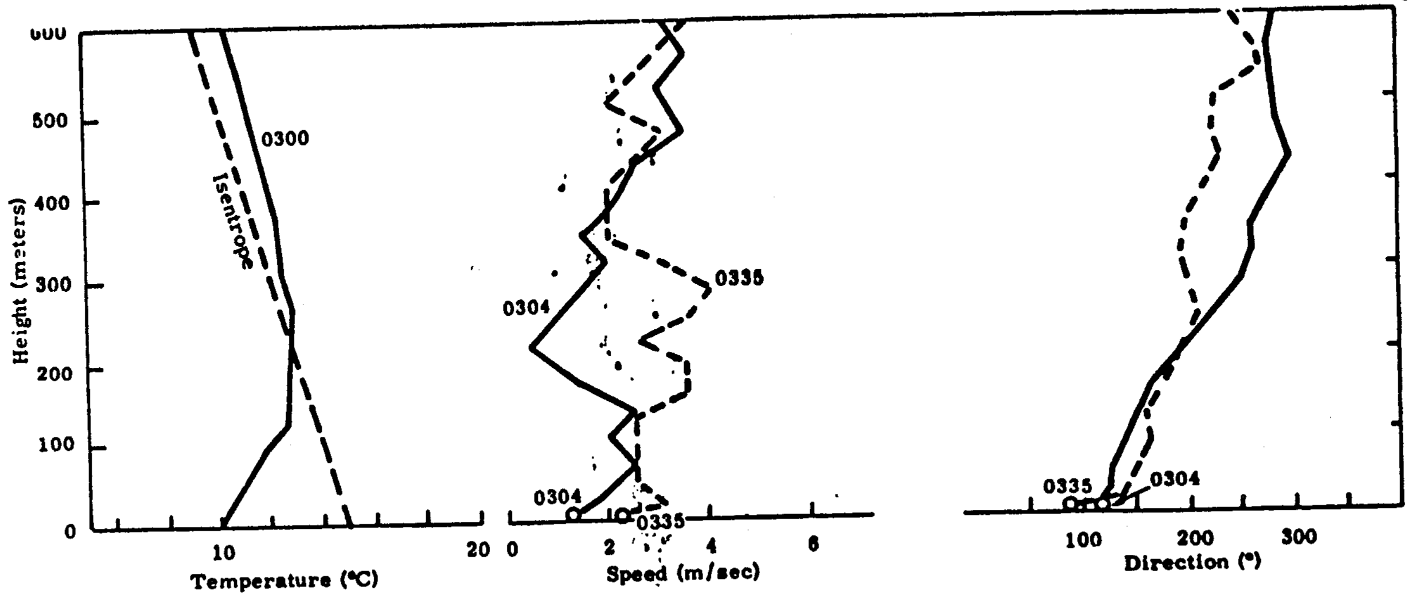


Figure A-6. HE Shot No. 8, 0304 PDT, 1600 Pounds;
HE Shot No. 9, 0335 PDT, 140 Pounds

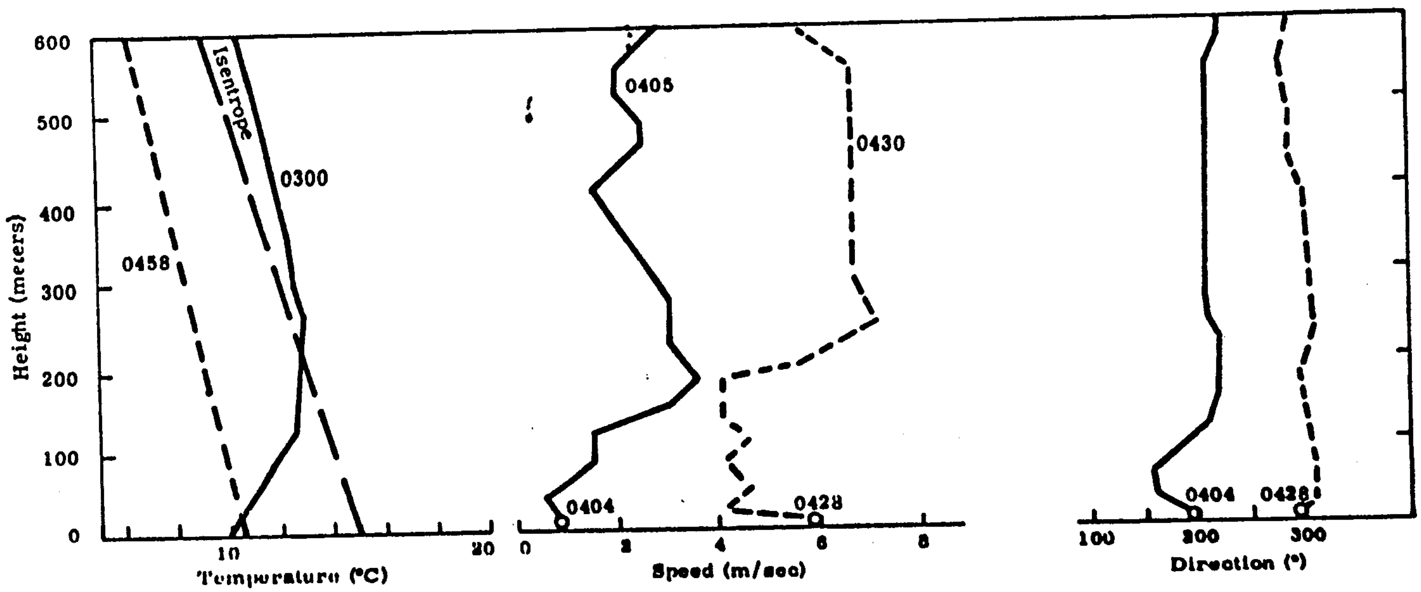


Figure A-7. HE Shot No. 10, 0404 PDT, 420 Pounds;
HE Shot No. 11, 0428 PDT, 140 Pounds

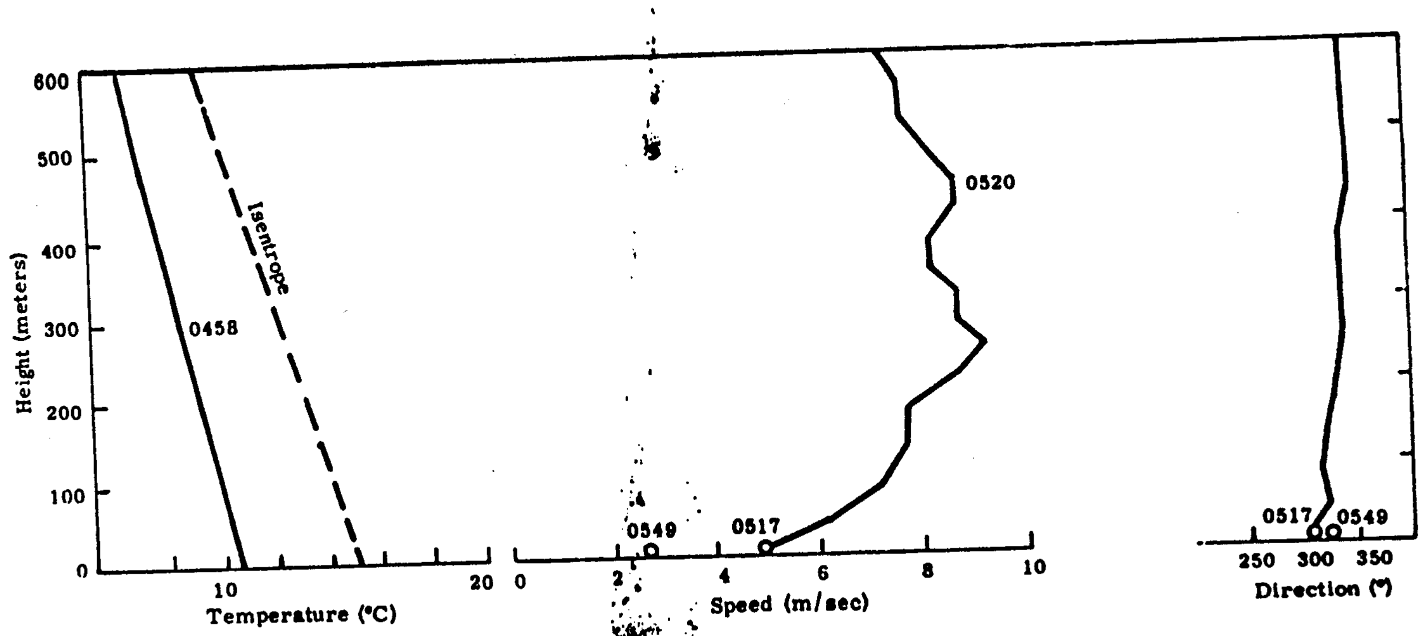


Figure A-8. HE Shot No. 12, 0517 PDT, 140 Pounds;
HE Shot No. 13, 0549 PDT, 560 Pounds

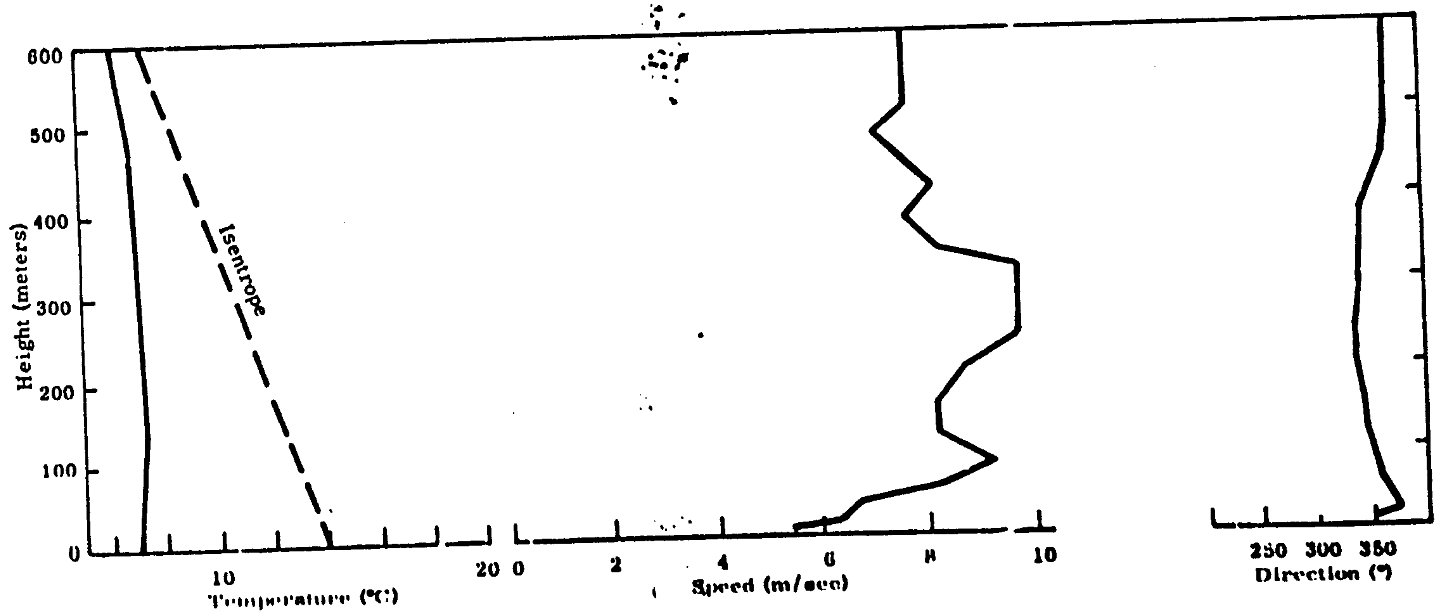


Figure A-9. Double Tracks, 0255 PDT, 118 Pounds

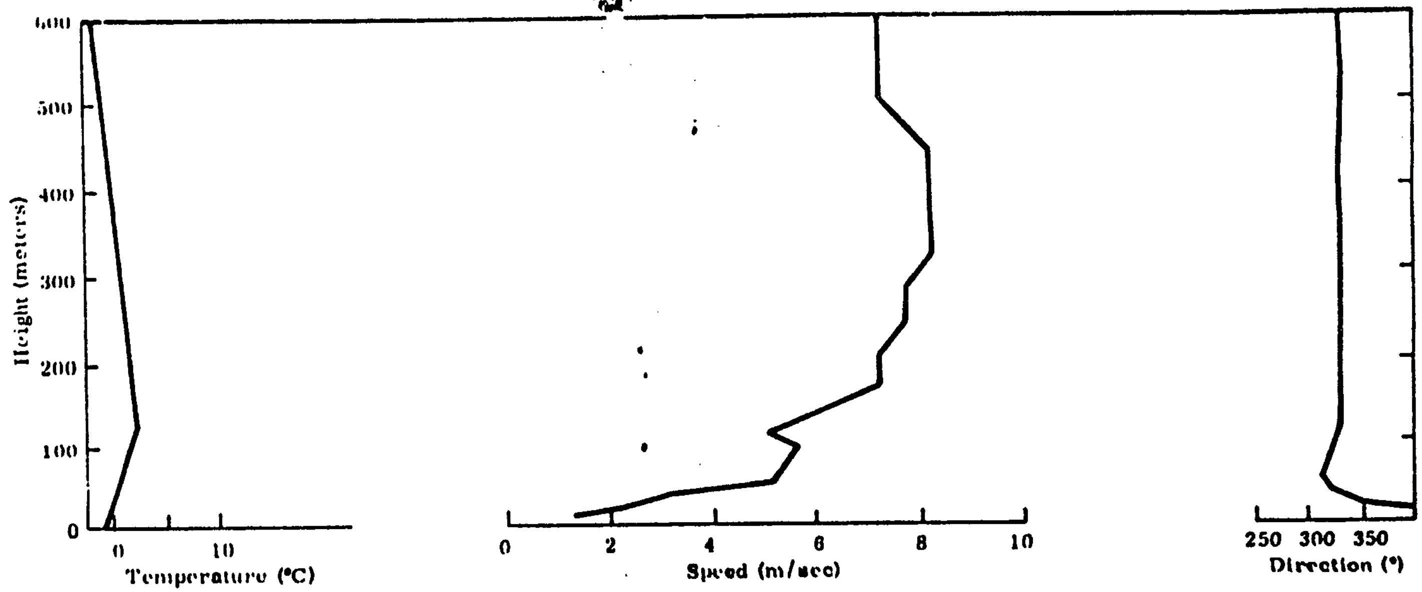


Figure A-10. Clean Slate 1, 0416 PDT, 1062 Pounds

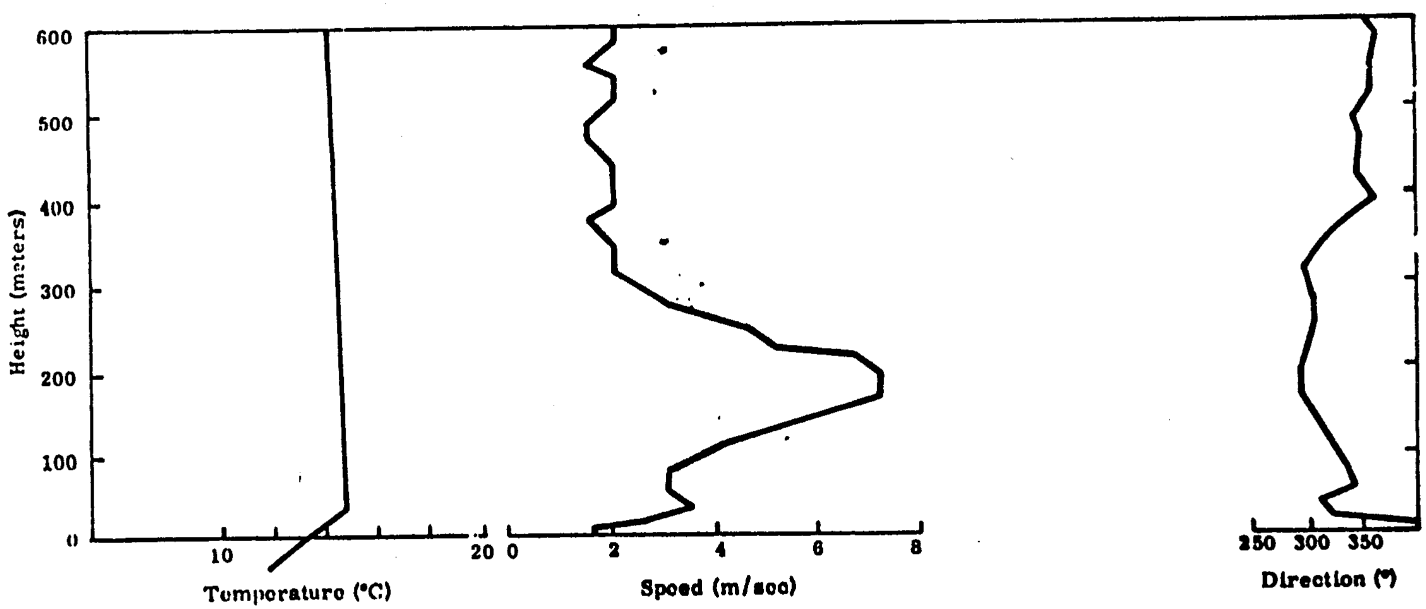


Figure A-11. Clean Slate 2, 0347 PDT, 2242 Pounds

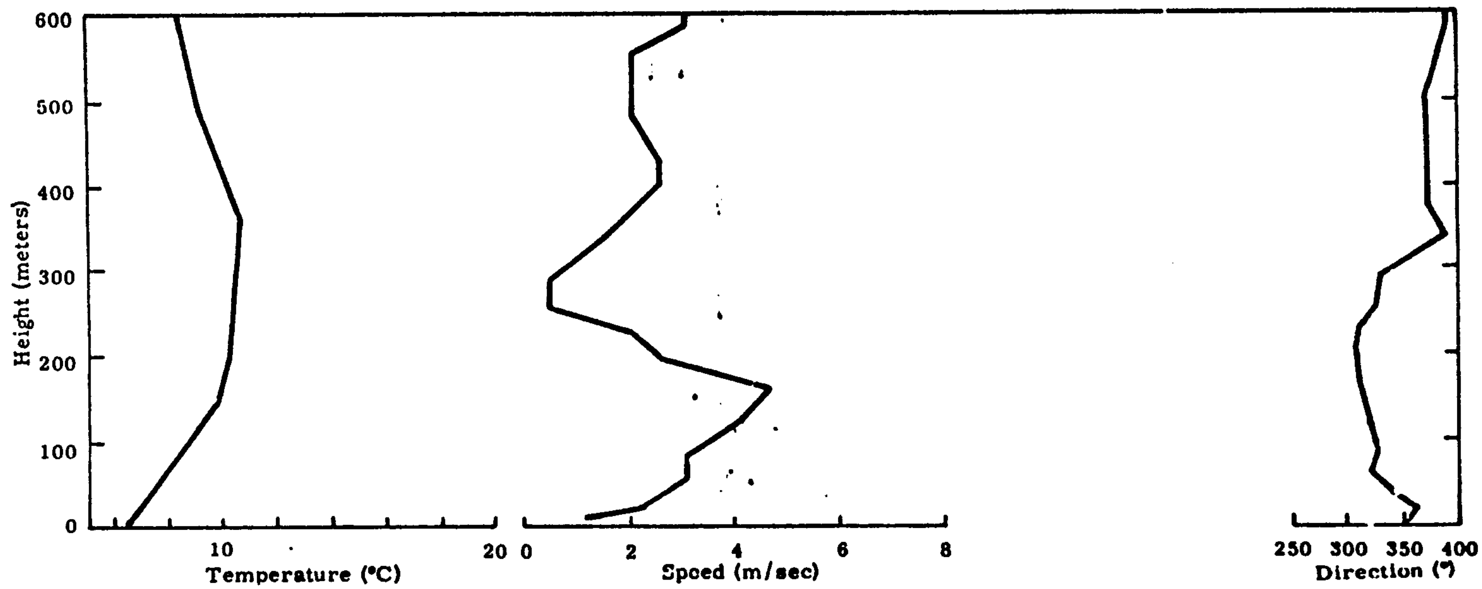


Figure A-12. Clean Slate 3, 0330 PDT, 2242 Pounds

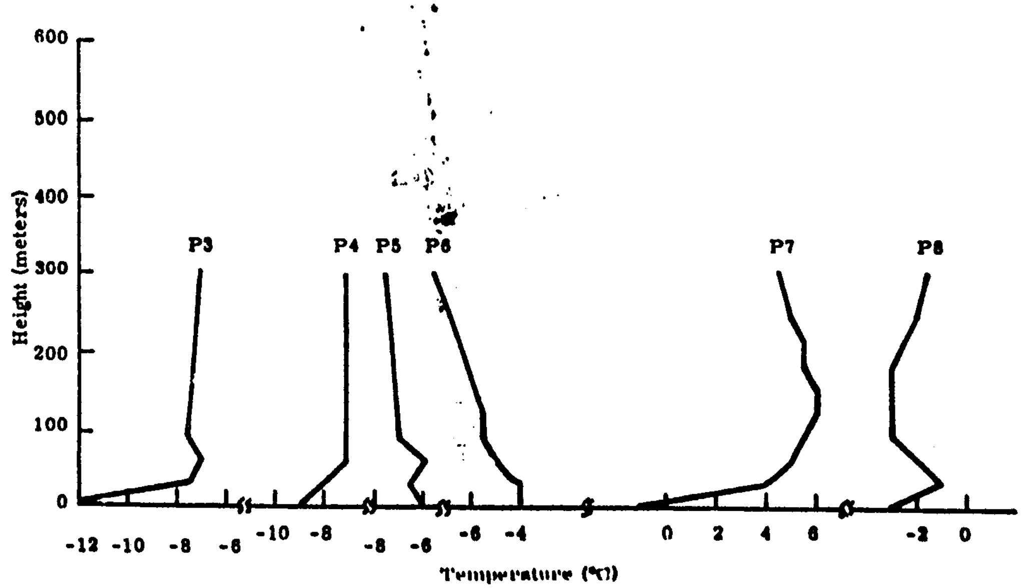


Figure A-13. Temperature Only for Preliminary HE Shots P3-P8

LIST OF REFERENCES

1. Luna, R. E. and Church, H. W., Difout: A Model for Computation of Aerosol Transport and Diffusion in the Atmosphere. Sandia Corporation, SC-RR-68-555, January 1969.

2. Slade, D. H. (ed), Meteorology and Atomic Energy - 1968, U. S. Gov. Printing Office, Washington, D.C., TID-24190, USAEC, July 1968.

3. Morton, B. R., Taylor, Sir Geoffrey, and Turner, J. S., "Turbulent Gravitational Convection from Maintained and Instantaneous Sources," Proc. Roy. Soc., A, V234, pp. 1-23, 1956.

4. Glasstone, S. (ed), The Effects of Nuclear Weapons, U.S. Gov. Printing Office, Washington, D.C., USAEC, April 1962.

5. U.S.W.B., Meteorological Research Project, "Announced Nuclear Detonations," Fallout Program Quarterly Summary Report, Health and Safety Laboratory, HASL-142, pp. 218-239, January 1964.

6. Beasley, R. R., Operation Roller Coaster Technical Photography, Defense Atomic Support Agency, POR-2519, OUO, August 1965.

7. Titus, R. W., Operation Roller Coaster Micrometeorological Measurements, Defense Atomic Support Agency, POR-2504, OUO, July 1965.

8. Grossman, B. H., Machta, L., Quenneville, L. R., Dossi, S. W., and Halsey, J., Operation Teapot Atomic Cloud Growth Study, Armed Forces Special Weapons Project, WT-1152, Uncl., October 1955.

9. Thyer, N., "Double Theodolite Pibal Evaluation by Computer," J. of Appl. Meteorol., V. 1, pp. 66-68, March 1962.

APPENDIX F-3

COMPARISON OF SCREEN VERSUS TSCREEN MODELING RESULTS

APPENDIX F-3

COMPARISON OF SCREEN VERSUS TSCREEN MODELING RESULTS

TSCREEN is an alternative screening model to SCREEN (U.S. EPA, 1990). In particular, the SCREEN or PUFF option of TSCREEN may be useful for OB/OD sources. A comparison of SCREEN (nonflare) versus TSCREEN-SCREEN (nonflare) and TSCREEN-SCREEN (nonflare) modeling results is presented in Table F-3-1. These data indicate the SCREEN and TSCREEN-SCREEN are identical. However, TSCREEN predicts significantly higher 1-hr maximum concentrations when the PUFF option is used. A further evaluation to determine the reason for these differences was not conducted. It is recommended that SCREEN, INPUFF or alternative models be used in lieu of TSCREEN-PUFF for OB/OD screening modeling.

Table F-3-1. Comparison of SCREEN versus TSCREEN 1-hour concentration modeling results[a]

Parameter	SCREEN	TSCREEN	
		SCREEN	PUFF
Emission rate (g/s)	1	1	1
Stack height (m)	0.0	0.0	0.0
Stack inside diameter (m)	0.000001	0.000001	-
Stack exit velocity (m/s)	0.0	0.0	-
Stack exit temperature (°K)	293	293	-
Ambient air temperature (°K)	293	293	-
Receptor height (m)	0.0	0.0	0.0
Maximum 1-hr concentration ($\mu g/m^3$)	3.4E4	3.4E4	3.2E5
Distance to maximum concentration (m)	100	100	100
Plume height at maximum concentration (m)	0.0	0.0	0.0

[a]Based on full meteorology.

*** SCREEN-2.0 MODEL RUN ***
*** VERSION DATED 92100 ***

screen run

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000000
STACK HEIGHT (M)	=	.000000
STK INSIDE DIAM (M)	=	.000001
STK EXIT VELOCITY (M/S)	=	.000000
STK GAS EXIT TEMP (K)	=	293.000000
AMBIENT AIR TEMP (K)	=	293.000000
RECEPTOR HEIGHT (M)	=	.000000
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	.000000
MIN HORIZ BLDG DIM (M)	=	.000000
MAX HORIZ BLDG DIM (M)	=	.000000

BUOY. FLUX = .00 M**4/S**3; MOM. FLUX = .00 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.3364E+05	6	1.0	1.0	5000.0	.0	4.1	2.3	NO
200.	.1006E+05	6	1.0	1.0	5000.0	.0	7.7	4.1	NO
300.	5038.	6	1.0	1.0	5000.0	.0	11.2	5.6	NO
400.	3086.	6	1.0	1.0	5000.0	.0	14.6	7.0	NO
500.	2110.	6	1.0	1.0	5000.0	.0	18.0	8.4	NO
600.	1548.	6	1.0	1.0	5000.0	.0	21.2	9.7	NO
700.	1191.	6	1.0	1.0	5000.0	.0	24.5	10.9	NO
800.	961.8	6	1.0	1.0	5000.0	.0	27.6	12.0	NO
900.	796.7	6	1.0	1.0	5000.0	.0	30.8	13.0	NO
1000.	673.3	6	1.0	1.0	5000.0	.0	33.9	14.0	NO
1100.	581.1	6	1.0	1.0	5000.0	.0	37.0	14.8	NO
1200.	508.0	6	1.0	1.0	5000.0	.0	40.0	15.7	NO
1300.	449.0	6	1.0	1.0	5000.0	.0	43.0	16.5	NO
1400.	400.5	6	1.0	1.0	5000.0	.0	46.0	17.3	NO
1500.	360.1	6	1.0	1.0	5000.0	.0	49.0	18.0	NO
1600.	326.0	6	1.0	1.0	5000.0	.0	52.0	18.8	NO
1700.	296.9	6	1.0	1.0	5000.0	.0	54.9	19.5	NO
1800.	271.9	6	1.0	1.0	5000.0	.0	57.9	20.2	NO
1900.	250.1	6	1.0	1.0	5000.0	.0	60.8	20.9	NO
2000.	231.1	6	1.0	1.0	5000.0	.0	63.7	21.6	NO
2100.	215.3	6	1.0	1.0	5000.0	.0	66.6	22.2	NO
2200.	201.3	6	1.0	1.0	5000.0	.0	69.4	22.8	NO
2300.	188.7	6	1.0	1.0	5000.0	.0	72.3	23.3	NO
2400.	177.4	6	1.0	1.0	5000.0	.0	75.1	23.9	NO
2500.	167.2	6	1.0	1.0	5000.0	.0	77.9	24.4	NO
2600.	158.0	6	1.0	1.0	5000.0	.0	80.8	25.0	NO
2700.	149.5	6	1.0	1.0	5000.0	.0	83.6	25.5	NO
2800.	141.9	6	1.0	1.0	5000.0	.0	86.4	26.0	NO
2900.	134.8	6	1.0	1.0	5000.0	.0	89.1	26.5	NO

3500.	104.0	6	1.0	1.0	5000.0	.0	105.7	29.0	NO
4000.	86.62	6	1.0	1.0	5000.0	.0	119.2	30.8	NO
4500.	73.75	6	1.0	1.0	5000.0	.0	132.5	32.6	NO
5000.	63.88	6	1.0	1.0	5000.0	.0	145.7	34.2	NO
5500.	56.10	6	1.0	1.0	5000.0	.0	158.7	35.8	NO
6000.	49.83	6	1.0	1.0	5000.0	.0	171.6	37.2	NO
6500.	44.68	6	1.0	1.0	5000.0	.0	184.3	38.6	NO
7000.	40.39	6	1.0	1.0	5000.0	.0	197.0	40.0	NO
7500.	36.90	6	1.0	1.0	5000.0	.0	209.5	41.2	NO
8000.	33.91	6	1.0	1.0	5000.0	.0	222.0	42.3	NO
8500.	31.33	6	1.0	1.0	5000.0	.0	234.3	43.4	NO
9000.	29.07	6	1.0	1.0	5000.0	.0	246.6	44.4	NO
9500.	27.09	6	1.0	1.0	5000.0	.0	258.8	45.4	NO
10000.	25.33	6	1.0	1.0	5000.0	.0	270.9	46.4	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

100.	.3364E+05	6	1.0	1.0	5000.0	.0	4.1	2.3	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
********************************************
*  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
*    SIMPLE ELEVATED TERRAIN PROCEDURE     *
********************************************
```

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	100.	10000.

```
***************************************
*** SUMMARY OF SCREEN MODEL RESULTS ***
***************************************
```

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.3364E+05	100.	0.

```
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

10/10/94
13:57:31

*** SCREEN2 MODEL RUN ***
*** VERSION DATED 92245 ***

tscreen screen run

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.00000
STACK HEIGHT (M)	=	.0000
STK INSIDE DIAM (M)	=	.0000
STK EXIT VELOCITY (M/S)	=	.0000
STK GAS EXIT TEMP (K)	=	293.0000
AMBIENT AIR TEMP (K)	=	293.0000
RECEPTOR HEIGHT (M)	=	.0000
URBAN/RURAL OPTION	=	RURAL
BUILDING HEIGHT (M)	=	.0000
MIN HORIZ BLDG DIM (M)	=	.0000
MAX HORIZ BLDG DIM (M)	=	.0000

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.3364E+05	100.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

BUOY. FLUX = .000 M**4/S**3; MOM. FLUX = .000 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.3364E+05	6	1.0	1.0	10000.0	.00	4.07	2.33	NO
200.	.1006E+05	6	1.0	1.0	10000.0	.00	7.73	4.09	NO
300.	5038.	6	1.0	1.0	10000.0	.00	11.23	5.62	NO
400.	3086.	6	1.0	1.0	10000.0	.00	14.64	7.05	NO
500.	2110.	6	1.0	1.0	10000.0	.00	17.97	8.40	NO
600.	1548.	6	1.0	1.0	10000.0	.00	21.24	9.69	NO
700.	1191.	6	1.0	1.0	10000.0	.00	24.46	10.93	NO
800.	961.8	6	1.0	1.0	10000.0	.00	27.63	11.98	NO
900.	796.7	6	1.0	1.0	10000.0	.00	30.78	12.98	NO
1000.	673.3	6	1.0	1.0	10000.0	.00	33.88	13.95	NO
1100.	581.1	6	1.0	1.0	10000.0	.00	36.96	14.82	NO
1200.	508.0	6	1.0	1.0	10000.0	.00	40.01	15.66	NO
1300.	449.0	6	1.0	1.0	10000.0	.00	43.04	16.47	NO

1500.	360.1	6	1.0	1.0	10000.0	.00	49.05	18.05	NO
1600.	326.0	6	1.0	1.0	10000.0	.00	51.99	18.78	NO
1700.	296.9	6	1.0	1.0	10000.0	.00	54.94	19.52	NO
1800.	271.9	6	1.0	1.0	10000.0	.00	57.87	20.23	NO
1900.	250.1	6	1.0	1.0	10000.0	.00	60.78	20.94	NO
2000.	231.1	6	1.0	1.0	10000.0	.00	63.68	21.63	NO
2100.	215.3	6	1.0	1.0	10000.0	.00	66.56	22.21	NO
2200.	201.3	6	1.0	1.0	10000.0	.00	69.42	22.78	NO
2300.	188.7	6	1.0	1.0	10000.0	.00	72.28	23.34	NO
2400.	177.4	6	1.0	1.0	10000.0	.00	75.12	23.89	NO
2500.	167.2	6	1.0	1.0	10000.0	.00	77.95	24.42	NO
2600.	158.0	6	1.0	1.0	10000.0	.00	80.76	24.95	NO
2700.	149.5	6	1.0	1.0	10000.0	.00	83.57	25.47	NO
2800.	141.9	6	1.0	1.0	10000.0	.00	86.36	25.98	NO
2900.	134.8	6	1.0	1.0	10000.0	.00	89.15	26.48	NO
3000.	128.4	6	1.0	1.0	10000.0	.00	91.92	26.98	NO
3500.	104.0	6	1.0	1.0	10000.0	.00	105.65	28.98	NO
4000.	86.62	6	1.0	1.0	10000.0	.00	119.17	30.84	NO
4500.	73.75	6	1.0	1.0	10000.0	.00	132.50	32.57	NO
5000.	63.88	6	1.0	1.0	10000.0	.00	145.67	34.21	NO
5500.	56.10	6	1.0	1.0	10000.0	.00	158.69	35.76	NO
6000.	49.83	6	1.0	1.0	10000.0	.00	171.58	37.23	NO
6500.	44.68	6	1.0	1.0	10000.0	.00	184.34	38.64	NO
7000.	40.39	6	1.0	1.0	10000.0	.00	196.99	40.00	NO
7500.	36.90	6	1.0	1.0	10000.0	.00	209.54	41.16	NO
8000.	33.91	6	1.0	1.0	10000.0	.00	221.98	42.28	NO
8500.	31.33	6	1.0	1.0	10000.0	.00	234.34	43.36	NO
9000.	29.07	6	1.0	1.0	10000.0	.00	246.61	44.40	NO
9500.	27.09	6	1.0	1.0	10000.0	.00	258.79	45.41	NO
10000.	25.33	6	1.0	1.0	10000.0	.00	270.90	46.38	NO
15000.	14.93	6	1.0	1.0	10000.0	.00	388.43	54.88	NO
20000.	10.54	6	1.0	1.0	10000.0	.00	500.95	60.29	NO
25000.	8.049	6	1.0	1.0	10000.0	.00	609.75	64.86	NO
30000.	6.462	6	1.0	1.0	10000.0	.00	715.59	68.84	NO
40000.	4.644	6	1.0	1.0	10000.0	.00	920.22	74.49	NO
50000.	3.597	6	1.0	1.0	10000.0	.00	1117.42	79.19	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

100.	.3364E+05	6	1.0	1.0	10000.0	.00	4.07	2.33	NO

```
DIST    = DISTANCE FROM CENTER OF THE AREA SOURCE
CONC    = MAXIMUM GROUND LEVEL CONCENTRATION
STAB    = ATMOSPHERIC STABILITY CLASS (1=A, 2=B, 3=C, 4=D, 5=E, 6=F)
U10M    = WIND SPEED AT THE 10-M LEVEL
USTK    = WIND SPEED AT STACK HEIGHT
MIX HT  = MIXING HEIGHT
PLUME HT= PLUME CENTERLINE HEIGHT
SIGMA Y = LATERAL DISPERSION PARAMETER
SIGMA Z = VERTICAL DISPERSION PARAMETER
DWASH   = BUILDING DOWNWASH:
          DWASH=   MEANS NO CALC MADE (CONC = 0.0)
          DWASH=NO MEANS NO BUILDING DOWNWASH USED
          DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
          DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
          DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

***********************************
*** END OF SCREEN MODEL OUTPUT ***
***********************************
```

```
tscreen puff run

   TOTAL AMOUNT OF MATERIAL RELEASED (G):   3600.
         RELEASE HEIGHT ABOVE GROUND (M):   .0000
 INITIAL LATERAL DISPERSION SIGMA (Y) (M):  .0000
INITIAL VERTICAL DISPERSION SIGMA (Z) (M):  .0000

 ******************************************************
 ***         SUMMARY OF PUFF MODEL RESULTS          ***
 ******************************************************

THE MAXIMUM CONCENTRATION AND THE DISTANCE TO MAXIMUM
CONCENTRATION FOR DISTANCES BEYOND FENCELINE    .100 (KM).
FOR NEAR SURFACE RELEASE MAXIMUM CONCENTRATION WILL OCCUR AT
THE FENCELINE.

   AVERAGING          MAXIMUM            DISTANCE TO       STABILITY
   TIME (MIN)     CONCENTRATION (G/M**3) MAX. CONC. (KM)    CLASS

 INSTANTANEOUS          3.687E+02          .100              S
*        1              1.910E+01          .100              S
         5              3.820E+00          .100              S
        15              1.273E+00          .100              S
        60              3.183E-01          .100              S
                       3.183 E+5 µg/m3
 ******************************************************
 **  REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS  **
 ******************************************************


 *********************************
 ***      PUFF DISTANCES      ***
 *********************************

 THE MAXIMUM CONCENTRATION AS A FUNCTION OF DOWNWIND DISTANCE
 AND THE CONDITIONS THAT PRODUCED THE MAXIMUM AT THAT DISTANCE.


 MIXING HEIGHT (M)   320.
 WIND SPEED (M/SEC)    1.0

 AVERAGING                          DOWNWIND DISTANCE (KM)
 TIME (MIN)   MAXIMUM CONCENTRATION (G/M**3) AT VARIOUS DOWNWIND DISTANCES.
                  STABILITY CLASS THAT PRODUCED THE MAX. LISTED BELOW
             0.01      0.03      0.05      0.07      0.1       0.5
 ========================================================================
 INST.   3.619E+04 5.400E+03 1.809E+03 8.438E+02 3.687E+02 8.087E+00
             S         S         S         S         S         S
*1       6.040E+02 1.162E+02 5.402E+01 3.261E+01 1.910E+01 1.708E+00
             S         S         S         S         S         S
 5       1.208E+02 2.325E+01 1.080E+01 6.522E+00 3.820E+00 3.416E-01
             S         S         S         S         S         S
 15      4.026E+01 7.749E+00 3.601E+00 2.174E+00 1.273E+00 1.139E-01
             S         S         S         S         S         S
 60      1.007E+01 1.937E+00 9.003E-01 5.435E-01 3.183E-01 2.847E-02
             S         S         S         S         S         S



 AVERAGING                          DOWNWIND DISTANCE (KM)
 TIME (MIN)   MAXIMUM CONCENTRATION (G/M**3) AT VARIOUS DOWNWIND DISTANCES.
                  STABILITY CLASS THAT PRODUCED THE MAX. LISTED BELOW
```

==

INST.	1.545E+00	1.119E-01	3.300E-02	1.476E-02	6.295E-03	4.556E-04
	S	S	S	S	S	S
*1	6.031E-01	8.976E-02	3.004E-02	1.401E-02	6.121E-03	4.539E-04
	S	S	S	S	S	S
5	1.208E-01	2.325E-02	1.080E-02	6.492E-03	3.671E-03	4.137E-04
	S	S	S	S	S	S
15	4.026E-02	7.749E-03	3.601E-03	2.174E-03	1.273E-03	2.402E-04
	S	S	S	S	S	S
60	1.007E-02	1.937E-03	9.003E-04	5.435E-04	3.183E-04	6.126E-05
	S	S	S	S	S	S

STABILITY CLASSES
U = UNSTABLE
N = NEUTRAL
S = STABLE

* INDICATES AVERAGING TIME THAT WAS SELECTED FOR PLOTTING

****
*** END OF PUFF MODEL OUTPUT ***
****

APPENDIX F-4

COMPARISON OF OTHER DISPERSION MODELS FOR OB/OD SOURCES

F-4 COMPARISON OF OTHER DISPERSION MODELS FOR OB/OD SOURCES

Primary candidate dispersion models for OB/OD sources include the following:

- INPUFF (see F-4.1)
- ISC2 (see F-4.2)
- SCREEN (see F-4.3)
- CTSCREEN (see F-4.4)

A comparison of modeling results for these models is presented in Appendix F-4.5.

F-4.1 INPUFF

The U.S. EPA dispersion model INPUFF should be used to account for the near-instantaneous nature of the source release condition and dispersion associated with OB/OD units (U.S. EPA, 1986a). The INPUFF model simulates dispersion from semi-instantaneous or continuous point sources over a spatially and temporally variable wind field. The dispersion modeling approach is based on Gaussian puff assumptions. Three dispersion algorithms are incorporated within the model to account for initial dispersion, short travel time dispersion, and long travel time dispersion. Short-term dispersion is based either on the use of standard Pasquil-Gifford dispersion factors (developed for continuous sources) or on onsite meteorological data. Plume rise is based on standard Briggs equations (developed for continuous sources). The model does not have separate plume rise algorithms for instantaneous and continuous releases, and it computes only 144 time steps (user-defined steps in minutes). Therefore, INPUFF is best suited to evaluate source/meteorological scenarios and is not capable of processing a 1- to 5-year meteorological data file. The model does not directly account for complex terrain but allows some adjustment for source and receptor height and simulates terrain-induced wind fields if data from multiple onsite meteorological stations are available. INPUFF does not account for chemical transformations.

F-4.2 ISC2

The Industrial Source Complex (ISC) model is the preferred U.S. EPA regulatory model for complicated emission sources located in simple terrain (U.S. EPA, 1986a, 1987). Complicated sources include area and volume sources, as well as point releases, which are needed to account for deposition. Simple terrain is considered as flat or rolling topography. The ISC model is a steady-state Gaussian plume using standard Briggs plume rise equations and Pasquil-Gifford dispersion factors. Therefore, the model is applicable to continuous release for the predictions of concentrations for 1 hr to annual averaging times. Settling and dry deposition of particulates are accounted for by ISC. The model, however, is not applicable to instantaneous sources.

In June 1992, U.S. EPA released the completely reprogrammed ISCS2 model (ISC2), which includes an updated source code, a modified data entry system, and technical changes related to building downwash and previously identified "bugs." In addition, ISC2 includes an EVENT model for performing culpability analyses for user-specified combinations of source groups, averaging periods, data periods, and receptor locations.

F-4.3 SCREEN

The U.S. EPA model SCREEN uses a Gaussian plume model to estimate pollutant concentration from continuous sources and accounts for source-related factors and meteorological factors (U.S. EPA, 1980). It is assumed that the pollutant does not undergo any chemical reactions and that no other removal processes, such as wet or dry deposition, act on the plume during its transport from the source.

SCREEN examines a range of stability classes and wind speeds to identify the "worst case" meteorological conditions, i.e., the combination of wind speed and stability that results in the maximum ground-level concentrations.

The SCREEN model also contains the option to calculate maximum 24-hr concentrations for terrain elevations above stack height. A final plume height and distance to final rise are calculated based on the VALLEY model screening technique assuming conditions of F stability (E for urban), and a stack height wind speed of 2.5 m/s. However, these stable conditions are generally not applicable to OB/OD releases.

For the simple terrain calculation, SCREEN examines concentrations for the full range of meteorology and selects the highest ground-level concentration. Plume heights are reduced by the chopped-off terrain height for the simple terrain calculation.

F-4.4 CTSCREEN

The Complex Terrain Dispersion Model (CTDMPLUS) is a refined U.S. EPA air quality model for use in all atmospheric stabilities with sources located in or near complex topography (U.S. EPA, 1990). Since the model accounts for the three-dimensional nature of plume and terrain interaction, it requires detailed terrain and meteorological data that are representative of the modeling domain. Although the terrain data may be readily obtained from topographic maps and digitized for use in the CTDMPLUS, the required meteorological data may not be as readily available. CTSCREEN uses CTDMPLUS in a "screening" mode—actual source and terrain characteristics are modeled with an extensive array of predetermined meteorological conditions.

The CTDMPLUS screening model (CTSCREEN) serves several purposes in regulatory applications. When meteorological data are unavailable, CTSCREEN can be used to obtain conservative (safely above those refined models), yet realistic, impact estimates for particular sources.

It is important to note that CTSCREEN and the refined model, CTDMPLUS, are the same basic model. The primary difference in their make-up is in the way CTSCREEN obtains the meteorological conditions. For example, wind direction in CTSCREEN is calculated based on the source-terrain-dividing streamline geometry to ensure computation of the highest impacts that are likely to occur. The daytime mixed layer heights are based on fractions of the terrain height. Other meteorological variables or parameters are chosen through a variety of possible combinations from a predetermined matrix of values.

CTSCREEN requires the parameterization of individual hill shapes using the terrain preprocessor and the association of each model receptor with a particular hill (except for receptors in flat terrain, which CTSCREEN can also model).

In the modeling of stable and neutral conditions, a central feature of CTSCREEN is its use of a critical dividing-streamline height (H_c) to separate the flow in the vicinity of a hill into two layers. Flow in the upper layer has sufficient kinetic energy to pass over the top of a hill, while streamlines in the lower layer are constrained to flow in a horizontal plane around it. Two separate components of CTSCREEN compute ground-level concentrations resulting from plume material in each of these flows: LIFT handles the flow above H_c, and WRAP handles the flow below H_c.

In modeling unstable (convective) conditions, the model relies on a probability density function (PDF) description of the vertical velocities to estimate the vertical distribution of pollutant concentration. Terrain distortion of plume parcel trajectories are accounted for, as are deflections of the daytime mixed layer height.

Hourly profiles of wind and temperature measurements are used by CTDMPLUS to compute plume rise, plume penetration, convective scaling parameters, the value of H_c, and the Froude number above H_c. In stable/neutral conditions the profiles of turbulence data are used to compute dispersion factor values at plume height.

The model calculates on an hourly (or appropriate steady averaging period) basis how the plume trajectory (and, in stable/neutral conditions, the shape) is deformed by each hill. The computed concentration at each receptor is then derived from the receptor position on the hill and the resultant plume position and shape.

CTSCREEN yields maximum concentration estimates that are near, yet on the conservative side of, those that would result from the use of CTDMPLUS with a full year of on-site meteorological data for the same source-terrain configuration.

F-4.5 COMPARISONS OF SIMPLE-TERRAIN MODELING RESULTS

Comparisons of SCREEN, ISCST2, ISCLT2, and INPUFF are summarized in Tables F-4.5-1 and F-4.5-2. Results for OB sources are presented in Table F-4.5-1 and for OD sources in Table F-4.5-2. Source parameters for the scenarios modeled and meteorological conditions evaluated are identified in each table.

The SCREEN model was evaluated for the nonflare and flare options for OB. All releases were assumed to be continuous except for 1-min, 15-min, and 1-hr exposure results from INPUFF (which were assumed to be associated with a semi-instantaneous release).

A summary of the maximum concentrations for each model/downwind-distance combination is presented in Table F-4.5-3 for OB and F-4.5-4 for OD.

Table F-4.5-1. Summary results for various dispersion models - OB

Source parameters:
Emission rate: 1g/s (cont. release)
Emission rate: 60g/s for 1 min. (inst. release)

Stack height: 0.5m
Stack exit velocity: 1m/s
Stack diameter: 3.08m
Stack gas exit temperature: 440.3 K
Ambient temperature: 293 K

Meteorological conditions: Stability A; 1.34 m/s

Receptor distance (m)	Concentrations ($\mu g/m^3$)						
	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCLT2 (cont.)[a]	INPUFF (cont.)[a]	INPUFF (1 min.)	INPUFF (15 min.)	INPUFF (1 hr)
100	0.42	0.39	0.75	1.24	41.24	5.01	1.25
500	15.16	15.12	22.19	10.27	234.10	41.20	10.30
1000	3.33	2.46	3.29	2.18	27.91	8.58	2.15
2000	1.81	0.32	0.39	0.30	7.19	1.10	0.30
3000	1.27	0.18	0.21	0.16	0.66	0.50	0.16
4000	0.99	0.14	0.16	0.12	0.40	0.33	0.12
5000	0.82	0.12	0.13	0.10	0.27	0.24	0.10
Plume rise (m)	74.50			88.51	88.51	88.51	88.51

Meteorological conditions: Stability A; 3.0 m/s

Receptor distance (m)	Concentrations ($\mu g/m^3$)						
	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCLT2 (cont.)[a]	INPUFF (cont.)[a]	INPUFF (1 min.)	INPUFF (15 min.)	INPUFF (1 hr)
100	24.12	22.52	39.63	14.09	561.50	56.70	14.20
500	8.47	8.45	12.24	7.08	259.10	28.60	7.16
1000	1.12	1.12	1.49	1.06	24.40	4.20	1.05
2000	0.36	0.14	0.18	0.14	1.96	0.56	0.14
3000	0.25	0.08	0.09	0.07	0.65	0.29	0.07
4000	0.20	0.06	0.07	0.06	0.40	0.22	0.06
5000	0.16	0.05	0.06	0.05	0.27	0.17	0.05
Plume rise (m)	33.30			40.09	40.09	40.09	40.09

[a]1 hr.

Table F-4.5-1 (continued)

Meteorological conditions: Stability B; 1.34 m/s

Receptor distance (m)	Concentrations ($\mu g/m^3$)						
	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCLT2 (cont.)[a]	INPUFF (cont.)[a]	INPUFF (1 min.)	INPUFF (15 min.)	INPUFF (1 hr)
100	0.11	0.02	0.15	0.18	6.89	0.72	0.18
500	20.31	14.32	21.89	12.37	285.80	49.10	12.30
1000	10.96	12.13	10.85	8.34	123.50	33.10	8.28
2000	3.37	4.30	3.07	2.81	23.06	10.90	2.78
3000	1.78	2.04	1.35	1.34	7.58	4.83	1.31
4000	1.32	1.18	0.75	0.77	3.40	2.52	0.76
5000	1.08	0.77	0.15	0.49	1.81	1.46	0.49
Plume rise (m)	74.50			88.51	88.51	88.51	88.51

Meteorological conditions: Stability B; 5.0 m/s

Receptor distance (m)	Concentrations ($\mu g/m^3$)						
	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCLT2 (cont.)[a]	INPUFF (cont.)[a]	INPUFF (1 min.)	INPUFF (15 min.)	INPUFF (1 hr)
100	60.21	55.72	34.90	32.47	1247.00	129.00	32.30
500	13.84	13.79	7.30	12.14	389.10	48.30	12.10
1000	3.71	3.71	1.82	3.41	138.00	13.60	3.40
2000	0.95	0.95	0.43	0.89	23.88	3.54	0.88
3000	0.43	0.43	0.19	0.40	7.71	1.59	0.40
4000	0.24	0.24	0.10	0.23	3.42	0.90	0.23
5000	0.16	0.16	0.06	0.15	1.82	0.58	0.15
Plume rise (m)	20.00			24.45	24.45	24.45	24.45

[a]1 hr.

Table F-4.5-1 (continued)

Meteorological conditions: Stability C; 1.34 m/s

Receptor distance (m)	Concentrations ($\mu g/m^3$)						
	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCLT2 (cont.)[a]	INPUFF (cont.)[a]	INPUFF (1 min.)	INPUFF (15 min.)	INPUFF (1 hr)
100	0.02	0.02	0.03	0.00	0.16	0.16	0.00
500	16.50	16.12	12.07	6.27	60.14	25.40	6.34
1000	17.98	17.83	11.98	9.75	208.70	38.70	9.67
2000	8.51	8.49	5.27	5.92	70.57	23.50	5.87
3000	4.57	4.57	2.72	3.40	29.50	13.40	3.38
4000	2.84	2.83	1.64	2.19	14.63	8.31	2.16
5000	1.97	1.93	1.09	1.50	8.28	5.45	2.49
Plume rise (m)	74.50			94.77	94.77	94.77	94.77

Meteorological conditions: Stability C; 8.9 m/s

Receptor distance (m)	Concentrations ($\mu g/m^3$)						
	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCLT2 (cont.)[a]	INPUFF (cont.)[a]	INPUFF (1 min.)	INPUFF (15 min.)	INPUFF (1 hr)
100	128.20	116.64	94.11	61.85	3014.00	247.00	61.80
500	18.85	18.75	13.13	16.67	880.30	66.70	16.70
1000	5.57	5.56	3.66	5.18	238.90	20.70	5.18
2000	1.60	1.60	0.98	1.51	48.97	6.11	1.53
3000	0.77	0.77	0.45	0.73	24.30	2.84	0.71
4000	0.45	0.45	0.26	0.43	14.75	1.74	0.44
5000	0.30	0.30	0.17	0.29	8.19	1.16	0.29
Plume rise (m)	11.20			15.12	15.12	15.12	15.12

[a]1 hr.

Table F-4.5-1 (continued)

Meteorological conditions: Stability D; 1.34 m/s

Receptor distance (m)	Concentrations ($\mu g/m^3$)						
	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCLT2 (cont.)[a]	INPUFF (cont.)[a]	INPUFF (1 min.)	INPUFF (15 min.)	INPUFF (1 hr)
100	0.00	0.00	0.01	0.00	0.00	0.00	0.00
500	5.96	5.70	3.04	1.23	37.26	4.93	1.23
1000	13.31	13.00	5.91	3.17	101.40	12.70	3.18
2000	13.20	13.05	5.40	5.53	102.40	21.90	5.49
3000	10.33	10.26	4.05	5.18	72.47	20.40	5.11
4000	8.01	7.96	3.05	4.20	46.69	16.60	4.16
5000	6.36	6.34	2.37	3.36	30.43	13.20	3.32
Plume rise (m)	74.50			100.81	100.81	100.81	100.81

Meteorological conditions: Stability D; 8.9 m/s

Receptor distance (m)	Concentrations ($\mu g/m^3$)						
	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCLT2 (cont.)[a]	INPUFF (cont.)[a]	INPUFF (1 min.)	INPUFF (15 min.)	INPUFF (1 hr)
100	75.98	61.31	33.14	8.70	426.80	34.80	8.70
500	44.22	43.50	20.15	31.71	1649.00	12.70	31.70
1000	15.31	15.22	6.63	13.16	575.60	52.40	13.10
2000	5.42	5.41	2.21	4.44	144.20	17.80	4.45
3000	2.93	2.92	1.15	2.26	97.29	8.89	2.22
4000	1.91	1.90	0.73	1.40	57.28	5.55	1.39
5000	1.37	1.37	0.51	0.95	29.59	3.37	0.93
Plume rise (m)	11.20			16.84	16.84	16.84	16.84

[a]1 hr.

Table F-4.5-2. Summary results for various dispersion models - OD

Source parameters:
Emission rate: 1g/s (cont. release)
Emission rate: 3600g/s @ first second (inst. release)

Stack height: 314.0m
Stack exit velocity: 0.03m/s
Stack diameter: 1.0m/s
Stack gas exit temperature: 293K
Ambient temperature: 293K

Meteorological conditions: Stability A; 1.34 m/s

	Concentrations ($\mu g/m^3$)								
Receptor distance (m)	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCST2 (cont. vol.)[a]	ISCLT2 (cont.)[a]	ISCLT2 (cont. vol.)[a]	INPUFF (cont.)[a]	INPUFF (1 min)	INPUFF (15 min)	INPUFF (1 hr)
100	0.00	0.00	0.00	0.00	0.00	0.31	6.28	1.23	0.31
500	0.19	0.17	2.71	0.25	1.76	1.74	28.09	6.92	1.74
1000	2.60	1.55	1.03	2.07	0.72	0.85	9.23	3.34	0.84
2000	1.43	0.25	0.25	0.31	0.18	0.21	1.13	0.74	0.20
3000	1.00	0.14	0.18	0.17	0.13	0.13	0.55	0.42	0.13
4000	0.78	0.11	0.14	0.12	0.10	0.11	0.35	0.29	0.11
5000	0.64	0.09	0.12	0.10	0.09	0.09	0.24	0.21	0.09
Plume rise (m)	311.10					314.05	314.05	314.05	314.05

Table F-4.5-2 (continued)

Meteorological conditions: Stability A; 3.0 m/s

Receptor distance (m)	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCST2 (cont. vol.)[a]	ISCLT2 (cont.)[a]	ISCLT2 (cont. vol.)[a]	INPUFF (cont.)[a]	INPUFF (1 min)	INPUFF (15 min)	INPUFF (1 hr)
	Concentrations ($\mu g/m^3$)								
100	0.00	0.00	0.00	0.00	0.00	0.14	5.76	0.55	0.14
500	0.09	0.08	0.92	0.11	0.79	0.78	23.87	3.10	0.78
1000	0.70	0.69	0.34	0.92	0.32	0.38	8.13	1.51	0.38
2000	0.28	0.11	0.08	0.14	0.08	0.09	1.09	0.37	0.09
3000	0.20	0.06	0.06	0.07	0.06	0.06	0.55	0.24	0.06
4000	0.16	0.05	0.05	0.06	0.05	0.05	0.35	0.18	0.05
5000	0.13	0.04	0.04	0.04	0.04	0.04	0.25	0.15	0.04
Plume rise (m)	311.00					314.02	314.02	314.02	314.02

Meteorological conditions: Stability B; 1.34 m/s

Receptor distance (m)	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCST2 (cont. vol.)[a]	ISCLT2 (cont.)[a]	ISCLT2 (cont. vol.)[a]	INPUFF (cont.)[a]	INPUFF (1 min)	INPUFF (15 min)	INPUFF (1 hr)
	Concentrations ($\mu g/m^3$)								
100	0.00	0.00	0.00	0.00	0.00	0.01	0.08	0.02	0.01
500	0.00	0.00	0.21	0.00	0.11	0.26	3.60	1.03	0.26
1000	0.19	0.18	1.20	0.18	0.68	0.94	10.13	3.71	0.93
2000	1.33	1.13	1.40	1.03	0.82	1.06	7.60	4.07	1.05
3000	1.28	0.86	0.96	0.75	0.56	0.74	3.91	2.62	0.74
4000	1.03	0.58	0.65	0.49	0.38	0.50	2.15	1.62	0.50
5000	0.85	0.40	0.46	0.33	0.26	0.36	1.28	1.04	0.36
Plume rise (m)	311.00					314.05	314.05	314.05	314.05

Table F-4.5-2 (continued)

Meteorological conditions: Stability B; 5.0 m/s

Receptor distance (m)	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCST2 (cont. vol.)[a]	ISCLT2 (cont.)[a]	ISCLT2 (cont. vol.)[a]	INPUFF (cont.)[a]	INPUFF (1 min)	INPUFF (15 min)	INPUFF (1 hr)
	Concentrations ($\mu g/m^3$)								
100	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.01
500	0.00	0.00	0.04	0.00	0.02	0.07	2.67	0.28	0.07
1000	0.05	0.05	0.24	0.02	0.09	0.25	7.85	1.00	0.25
2000	0.31	0.30	0.28	0.14	0.11	0.28	7.05	1.13	0.28
3000	0.23	0.23	0.19	0.10	0.07	0.20	3.74	0.79	0.20
4000	0.16	0.16	0.13	0.07	0.05	0.14	2.12	0.54	0.13
5000	0.11	0.11	0.09	0.04	0.04	0.10	1.23	0.38	0.10
Plume rise (m)	311.00					314.01	314.01	314.01	314.01

Meteorological conditions: Stability C; 1.34 m/s

Receptor distance (m)	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCST2 (cont. vol.)[a]	ISCLT2 (cont.)[a]	ISCLT2 (cont. vol.)[a]	INPUFF (cont.)[a]	INPUFF (1 min)	INPUFF (15 min)	INPUFF (1 hr)
	Concentrations ($\mu g/m^3$)								
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500	0.00	0.00	0.01	0.00	0.00	0.01	0.15	0.04	0.01
1000	0.00	0.00	0.13	0.00	0.06	0.12	1.67	0.49	0.13
2000	0.20	0.18	0.74	0.11	0.32	0.59	5.86	2.34	0.59
3000	0.65	0.62	1.02	0.37	0.43	0.79	6.05	3.05	0.79
4000	0.86	0.71	0.99	0.43	0.41	0.77	4.80	2.90	0.,77
5000	0.90	0.75	0.88	0.40	0.36	0.69	3.58	2.43	0.60
Plume rise (m)	311.10					314.05	314.05	314.05	314.05

Table F-4.5-2 (continued)

Meteorological conditions: Stability C; 8.9 m/s

Receptor distance (m)	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCST2 (cont. vol.)[a]	ISCLT2 (cont.)[a]	ISCLT2 (cont. vol.)[a]	INPUFF (cont.)[a]	INPUFF (1 min)	INPUFF (15 min)	INPUFF (1 hr)
	Concentrations ($\mu g/m^3$)								
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
1000	0.00	0.00	0.01	0.00	0.10	0.02	1.03	0.07	0.02
2000	0.03	0.03	0.08	0.02	0.05	0.09	3.36	0.35	0.09
3000	0.10	0.09	0.11	0.06	0.06	0.12	4.38	0.48	0.12
4000	0.12	0.11	0.11	0.07	0.06	0.12	4.27	0.46	0.12
5000	0.11	0.11	0.10	0.06	0.05	0.10	2.87	0.41	0.10
Plume rise (m)	311.00					314.01	314.01	314.01	314.01

Meteorological conditions: Stability D; 1.34 m/s

Receptor distance (m)	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCST2 (cont. vol.)[a]	ISCLT2 (cont.)[a]	ISCLT2 (cont. vol.)[a]	INPUFF (cont.)[a]	INPUFF (1 min)	INPUFF (15 min)	INPUFF (1 hr)
	Concentrations ($\mu g/m^3$)								
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1000	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
2000	0.00	0.00	0.00	0.00	0.00	0.03	0.40	0.11	0.03
3000	0.00	0.00	0.01	0.00	0.00	0.11	1.29	0.44	0.11
4000	0.00	0.00	0.04	0.00	0.01	0.22	2.15	0.88	0.22
5000	0.01	0.01	0.07	0.00	0.02	0.32	2.71	1.27	0.00
Plume rise (m)	311.00					314.04	314.04	314.04	314.04

Table F-4.5-2 (continued)

Meteorological conditions: Stability D; 8.9 m/s

Receptor distance (m)	Concentrations ($\mu g/m^3$)								
	SCREEN (cont.) Nonflare[a]	ISCST2 (cont.)[a]	ISCST2 (cont. vol.)[a]	ISCLT2 (cont.)[a]	ISCLT2 (cont. vol.)[a]	INPUFF (cont.)[a]	INPUFF (1 min)	INPUFF (15 min)	INPUFF (1 hr)
100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.02	0.00
3000	0.00	0.00	0.00	0.00	0.00	0.02	0.83	0.07	0.00
4000	0.00	0.00	0.00	0.00	0.00	0.03	1.29	0.13	0.00
5000	0.00	0.00	0.01	0.00	0.00	0.05	1.51	0.19	0.00
Plume rise (m)	311.00					314.01	314.01	314.01	314.01

[a] 1 hr.

Table F-4.5-3. Summary of maximum concentrations ($\mu g/m^3$) - OB

Source parameters:
Emission rate: 1g/s (cont. release)
Emission rate: 60g/s for 1 min (inst. release)

Stack height: 0.5m
Stack exit velocity: 1m/s
Stack diameter: 3.08m
Stack gas exit temperature: 440.3K
Ambient temperature: 293K

	Concentrations ($\mu g/m^3$)						
Receptor distance (m)	SCREEN (cont.) Nonflare	ISCST2 (cont.)	ISCLT2 (cont.)	INPUFF (cont.)	INPUFF (1 min)	INPUFF (15 min)	INPUFF (1 hr)
100	128.20	116.64	94.11	61.85	3014.00	247.00	61.80
500	44.22	43.50	22.19	31.71	1649.00	66.70	31.70
1000	17.98	17.83	11.98	13.16	575.60	52.40	13.10
2000	13.20	13.05	5.40	5.92	144.20	23.50	5.87
3000	10.33	10.26	4.05	5.18	97.29	20.40	5.11
4000	8.01	7.96	3.05	4.20	57.28	16.60	4.16
5000	6.36	6.34	2.37	3.36	29.59	13.20	3.32

Table F-4.5-4. Summary of maximum concentrations ($\mu g/m^3$) - OD

Source parameters:
Emission rate: 1g/s (cont. release)
Emission rate: 3600g/s @ first second (inst. release)

Stack height: 314.0m
Stack exit velocity: 0.03m/s
Stack diameter: 1.0m
Stack gas exit temperature: 293K
Ambient temperature: 293K

Meteorological Conditions: Stability A; 1.34 m/s

	Concentrations ($\mu g/m^3$)								
Receptor distance (m)	SCREEN (cont.) Nonflare	ISCST2 (cont.)	ISCST2 (cont. vol.)	ISCLT2 (cont.)	ISCLT2 (cont. vol.)	INPUFF (cont.)	INPUFF (1 min)	INPUFF (15 min)	INPUFF (1 hr)
100	0.00	0.00	0.00	0.00	0.00	0.31	6.28	1.23	0.31
500	0.19	0.17	2.71	0.25	1.76	1.74	28.09	6.92	1.74
1000	2.60	1.55	1.20	2.07	0.72	0.94	10.13	3.71	0.93
2000	1.43	1.13	1.40	1.03	0.82	1.06	7.60	4.07	1.05
3000	1.28	0.86	1.02	0.75	0.56	0.79	6.05	3.05	0.79
4000	1.03	0.71	0.99	0.49	0.41	0.77	4.80	2.90	0.77
5000	0.90	0.75	0.88	0.40	0.36	0.69	3.58	2.43	0.68

APPENDIX F-5

DEVELOPMENT AND USE OF CRITICAL SOURCE RELEASE PARAMETERS FOR AIR DISPERSION MODELING OF OPEN BURNING AND OPEN DETONATION TREATMENT UNITS

(Lucas and Bentley, June 1995)

Rev 0 (5/95)

Development and Use of Critical Source Release Parameters for Air Dispersion Modeling Of Open Burning and Open Detonation Treatment Units

Joseph H. Lucas
Brown and Root Environmental
661 Andersen Drive
Pittsburgh, PA 15220

John R. Bentley
Brown and Root Environmental
661 Andersen Drive
Pittsburgh, PA 15220

Air & Waste Management Association Conference
San Antonio, TX
June 1995

1.0 INTRODUCTION

The Resource Conservation and Recovery Act (RCRA), specifically Subpart X of 40 CFR (264.600-264.603), requires the development of environmental performance based standards for "miscellaneous" hazardous waste units used to treat, store or dispose of hazardous waste. The term "miscellaneous" unit refers to hazardous waste management units that do not fall within the definition of technical standards of 40 CFR 264, 40 CFR 146, or for research, development or demonstration permit under 40 CFR 270.66.

The Military Services and some commercial contractors use open burning (OB) and open detonation (OD) thermal treatment operations to demilitarize energetic materials such as propellants and explosives. At the present time, OB and OD treatment is considered the best available disposal method for these materials until such time that furnace or incinerator technology is approved for treatment of these materials. OB and OD operations are subject to the permitting requirements of Subpart X. A principal component of the Subpart X permit is an air pathway assessment which provides information on the potential exposure of human and environmental receptors to hazardous materials.

The air pathway analysis is usually conducted with the aid of air quality dispersion models which incorporate emissions data, meteorological data, and special computer algorithms to calculate pollutant release, transport and dispersion. The air quality dispersion models require accurate information on the source release parameters and meteorological data in order to calculate representative air quality impacts. In the case of OB and OD thermal treatment of energetic materials, insufficient data on source release parameters and the lack of sophisticated air dispersion models and regulatory guidance have presented numerous problems when conducting Subpart X air pathway analyses.

Because OB and OD treatment operations are typically associated with extreme exothermic reactions, it is virtually impossible to conduct source sampling to characterize source release parameters such as plume temperature and exit velocity. These parameters are required by air dispersion models in order to calculate final plume rise for buoyant sources. In an effort to overcome the lack of information regarding source release parameters and OB/OD plume height, field measurement programs were undertaken to collect information for the purpose of estimating release parameters and plume height for specific treatment quantities and meteorological conditions. The field programs utilized photography and plume tracking techniques to acquire information on plume behavior from the point of release to final plume rise.

This paper will discuss the field measurement programs and the techniques used to develop source release parameters. The paper concludes with a discussion of the problems and limitations associated with these techniques and what methods may be employed in future OB/OD air pathway assessments.

2.0 FIELD MEASUREMENTS

Field measurement techniques were developed to derive source release parameters for use in OB and OD dispersion modeling. Due to the violent physical force and high combustion temperatures associated OB and OD, it is not practical or economically feasible to measure plume exit velocity or

temperature. As an alternative, the final plumes resulting from OD were measured and used to back-calculate potential release parameters for air dispersion modeling. OB treatment was recorded on video and the films reviewed to estimate initial exit velocities. The resulting exit velocities were input directly to dispersion models along with temperatures calculated by thermodynamic models. Direct measurement of OB plume heights was not conducted at the time of OD plume height measurements due to the minimal OB treatment which occurred during this period. As a result, only previously collected OB exit velocity data was available for evaluation.

Two plume measurement studies were conducted at a U. S. Army installation that routinely conducts OD thermal treatment operations. Activities for each field study were reviewed and planned in cooperation with the regulatory agency responsible for issuing the Subpart X permit. Plume height data, for a limited set of energetic materials and meteorological conditions, were collected and used to support a subsequent air pathway demonstration study. Concurrent plume tracking and videotaping were used to record plume movement following the onset of 27 treatment events. Field data was then analyzed to estimate final plume height associated with treatment quantities ranging from 1,000 to 10,000 lbs. net explosive weight (NEW). An onsite meteorological monitoring station was used to record wind speed and wind direction measurements at the 10 meter level.

2.1 FIELD MEASUREMENT OF OPEN DETONATION PLUME HEIGHTS

A method was developed to estimate final plume rise for the OD thermal treatment processes conducted at an Army Depot which proposed to treat up to 10,000 lbs per surface detonation. The methodology consisted of using a theodolite to track the horizontal and vertical path of the plume centerline. Plume behavior and transport were simultaneously recorded on videotape. The plume centerline was estimated as the midpoint of the angles measured from the top and bottom of the plume. Locations of the OD area and theodolite were determined to calculate the initial horizontal distance and elevation difference between the theodolite and treatment operation. Onsite meteorological measurements along with visual observation were recorded to determine the direction of plume travel. This information was input into the following equations for a triangle to calculate the horizontal distance between the theodolite and plume centerline. Positioning the theodolite so that the treatment location was due north simplified the calculations.

$$a \sin(B) = b \sin(A) \tag{1}$$

$$c^2 = a^2 + b^2 - 2ab \cos(C) \tag{2}$$

For these equations, the angle C was always at the treatment location. Angle A was at the location of the theodolite when the winds were from the west. Angle B was at the location of the theodolite when the winds were from the east. The remaining angle in either case was at the horizontal location of the plume centerline. The side c was therefore always the calculated horizontal distance between the theodolite and the plume centerline at the time of the vertical measurement. If the wind direction angle was 90°, the distance c was calculated using

$$c = \frac{b}{\cos(A)} \quad \text{or} \quad c = \frac{a}{\cos(B)} \tag{3}$$

Once this distance was calculated. it was input into the following equation along with the vertical angle measured with the theodolite to calculate the height (H) of the plume centerline.

$$H = c \tan(\Theta) - (\text{Initial Elevation Difference}) \quad (4)$$

where

H = plume height
Θ = the vertical angle

The plume height is relative to the location of the theodolite and was adjusted by subtracting 460 feet, the difference in elevation between the OD area and the theodolite location. The initial elevation difference was estimated from topographic maps and calculated using the measured vertical angle to the OD area and the horizontal distance taken from the topographical maps. This comparison substantiated the usefulness of this method. Depending on the travel distance and direction, increases in terrain elevation at the point of the vertical measurement were also subtracted from the calculated plume height.

Several observations of horizontal and vertical angles were taken for plumes during a treatment event. The calculated plume heights were then compared with video tapes of the treatment events to determine if they were accurate relative to other measured plumes. If comparison with video tapes suggested that the final plume height was overestimated. a previous lower calculated plume height was used to represent that plume. Review of treatment video concluded that the recorded wind direction was not accurate in some cases. When this occurred. a conservative estimate of wind direction was made. In each case. assuming an east or west wind resulted in a smaller wind direction angle (90°). The estimated wind direction angle was then used to calculate the horizontal distance.

The calculated plume heights for each treatment operation were graphed versus the observed 10 meter wind speed. Prior to graphing, the data points were grouped based on quantity of net explosive weight (NEW) treated per detonation. The high explosive detonations observed during the site visits were approximately 1.000 and 2,000 pounds NEW, respectively. Several items treated by OD consisted primarily of propellant and black powder. Their plume heights are not included for comparison with the high explosive plume heights due to the large difference in quantity and explosive equivalent weight. Table 1 summarizes the results of plume height calculations for the treatment events included in the 1.000 and 2.000 pound OD groups.

The 1.000 and 2.000 pound treatment event plume height's and associated wind speed's are presented in Figures 1 and 2. respectively. These figures are used to support the use of a scaling factor to calculate plume heights for 10.000 pound detonations. which were not observed during the field studies. It was necessary to determine plume heights for 10.000 pound detonations because the installation was seeking permit approval at the maximum treatment quantity.

The calculated plume height scaling factor is based on a 1981 study[1] conducted by the Defense Nuclear Agency (DNA) which relates plume heights to NEW. The DNA study determined that plume height increased exponentially as $[\text{NEW(tons)}]^{.25}$.

The scaling factor can be calculated by using the 2.000 pound (1 ton) and 10.000 pound (5 tons) treatment quantity values in the equation. The ratio of the results (1.49) is used as a scaling factor to

convert the 2.000 pound plume height data points to 10.000 pound plume heights. The resulting 10,000 pound plume heights versus observed 10 meter wind speed graph are presented in Figure 3.

Figures 1 and 2 can be used to evaluate the use of the DNA scaling factor. In this example. the NEW quantities for 1.000 pounds (0.5 tons) and 2.000 (1.0 tons) are input into the equation and divided to calculate the 1,000 pound scaling factor

$$\text{Scaling Factor} = \frac{(1)^{.25}}{(0.5)^{.25}} = 1.19 \qquad (5)$$

Multiplying the plume height from Figure 1 for 7.8 mph (2,160 feet) by 1.19 will result in the estimated plume height (2,750 feet) for a 2,000 pound detonation with a 7.8 mph wind speed. This calculated plume height exceeds the observed plume height from Figure 2 (2,310 feet) by 11 percent. This exceedance could be justified by the conservative wind directions used to calculate several of the 2.000 pound plume heights. The use of the 2.000 pound data set to estimate 10,000 pound plume heights should therefore result in slightly conservative plume height values.

2.2 FIELD MEASUREMENTS OF OPEN BURNING EXIT VELOCITIES

Estimates of initial exit velocity for OB were calculated by reviewing video tapes of treatment operations taken at two weapons manufacturing facilities. The films were taken so that a nearby object of known dimension was perpendicular to a line from the camera to the treatment unit. In most cases. the burn pan was the nearby object. The length of the burn pan. as it appeared on a video display, was used to calculate a reference distance through which the plume was timed as it rose. The reference distance began immediately above the flame resulting from the treatment of various propellants. explosives or pyrotechnics. Several measurement estimates were made for each treatment event by independent personnel. then were averaged to compute OB exit velocities in meters per second (m/sec). Due to the measurements being made immediately above the point of release and during light wind conditions. the exit velocities calculated are virtually independent of wind speed.

The exit velocities recommended for propellants is 6 m/s and 3 m/s for explosives and energetic materials requiring auxiliary fuels to sustain treatment. The energetic materials treated can be divided into two classes. which are characterized by their ignitability and burn time. In general. propellants are easily ignited and burn quickly, whereas. explosives and pyrotechnics require fuel oil and dunnage to initiate and sustain the burn. The fuel assisted burns usually require several minutes to an hour to be completed.

3.0 SOURCE RELEASE PARAMETER DEVELOPMENT

The calculated final plume heights were used to back-calculate potential source release parameters for use in air dispersion modeling. The source release parameters having the greatest influence on the final plume height are exit velocity, exit temperature and release diameter. In all cases, the release diameter may be reasonably estimated by using the surface area of the treatment device to calculate an equivalent source diameter for OB or by using the OD crater diameter or a visually derived

estimate for OD. To determine the remaining critical release parameters incorporating the field measurements previously discussed requires two distinct methods which are discussed in Sections 3.1 and 3.2.

3.1 PLUME HEIGHT DERIVED PARAMETERS FOR OD

The procedure for estimating OD source parameters requires manipulating the exit temperature and velocity parameters until the dispersion model calculated plume height is equivalent to that calculated during the field measurements. All other model input parameters are selected prior to modeling and fixed. including the appropriate meteorological conditions which were required to be invariant during the model averaging period. Exit velocity manipulation will have the largest impact on obtaining modeled plume heights of 2.000 and 3,000 feet. which is the target range from the field investigation for detonation of 10.000 pounds.

3.2 OB EXIT VELOCITY AND TEMPERATURE

Exit velocity input parameters are taken directly from the field measurement data for the appropriate treatment unit. Typically. larger facilities have separate pans for the treatment of propellants, bulk explosives and pyrotechnics and full-up rounds. This requires that separate modeling demonstrations be conducted for each treatment process with dissimilar source release parameters.

The exit temperature input parameter was estimated from the POLU 13 combustion products computer model[2,3,4] for the specific type of material being treated. A large variety of energetic materials can be modeled with POLU 13 and the resulting data may be processed in several different ways. The data may be averaged for all or several of the most frequently treated materials to obtain a representative average. Alternately, the minimum temperature may be used to demonstrate at worst case conditions. An average temperature representative of a large number of propellants is 1.060 K°. which is less than 3 times smaller than the 3.700 K° temperature found in U.S. EPA Subpart X permitting guidance. For treatment of materials requiring auxiliary fuels, 672 K° has been used in several modeling demonstrations. This temperature is the average predicted by the POLU 13 model for fuel oil combustion. It is less than the temperature predicted for many items which require auxiliary fuels. but is used to account for the wide variety of materials and for the increased moisture content exhibited by some materials treated in this class.

4.0 CONCLUSIONS

The field measurement studies associated with this installation's Subpart X permit provided valuable information for the air pathway assessment regarding the behavior of OB and OD treatment plumes. In particular, study data indicated that the final plume rise of OB/OD plumes is a function of treatment quantity, the type of material treated. and prevailing meteorological conditions. Final plume heights measured in this studies for NEW treatment quantities of 1.000 and 2.000 lbs were estimated to range from a few hundred to approximately 1.200 meters. Plumes heights of this order of magnitude have the potential for long range transport and should be examined carefully relative to complex terrain features within 50 km of the source.

Because the operating conditions and the energetic materials treated can vary significantly from

installation to installation, it is highly recommended that a thorough investigation of installation practices and plume behavior be conducted prior to the start of any air pathway assessment activities. The plume tracking technique used in this study has limitations based on utilization of meteorological data collected only at the 10 meter level. Wind shear in the lowest layers of the atmosphere can have a dramatic effect on plume rise, transport and ultimately the calculation of the effective plume height, particularly if the plume has the potential to reach significant effective heights, as identified in these studies. It is strongly recommended that future plume tracking studies also incorporate meteorological data that describes wind speed and wind direction up to the estimated effective plume height. It is also recommended that regulatory personnel responsible for permit approval and modeling protocol approval be included in all field investigations to have a better understanding of air pathway issues and to clearly define their preferences regarding air assessment techniques. Until such time as the U. S. EPA issues Subpart X permitting guidance and develops more sophisticated air quality models for assessing puff release impacts on complex terrain and long range transport, persons responsible for conducting air pathway assessments will face unique and complex technical issues in designing representative and regulatory acceptable assessment protocols.

REFERENCES

1. Defense Nuclear Agency. High Explosives Field Tests-Explosive Phenomena and Environmental Impacts, AD/A135737, October 1981.

2. E. Baroody, The POLU 13L Program, Naval Surface Warfare Center, Indian Head, MD, April 1994.

3. E. Baroody and I. Tominack. Computer Predictions of Pollutant Products from Open Burning and Open Detonation of Navy Explosives and Propellants, Naval Ordnance Station, Indian Head, MD, January 1987.

4. U.S. Navy, Computer Predictions of Pollution Products from Open Burning and Open Detonation of Explosives and Propellant, Final Report, Indian Head, MD, August 1989.

5. U.S. Army, Development of Methodology and Technology for Identifying and Quantifying Emission Products from Open Burning and Open Detonation Thermal Treatment Methods, U.S. Army Armament, Munitions and Chemical Command, Rock Island, IL, January 1992.

6. U.S. Air Force. Characterization of Emissions Resulting from Thermal Treatment of Selected Explosive Munitions, prepared for the U.S. Air Force Combat Command by the U.S. Army, Dugway Proving Ground, UT, January 1994.

7. U.S. Environmental Protection Agency, INPUFF, A Multiple Source Gaussian Puff Dispersion Algorithm User's Guide, July 1986.

8. U.S. Environmental Protection Agency, User's Guide to Rough Terrain Diffusion Model (RTDM) Rev. 3.20, July 1987.

Table 1. Calculated Plume Heights Derived from Field Measurements of Open Detonation Plumes.

Day	Plume Height (ft)	NEW (lbs)	Wind Speed (mph)	Temperature °F
3/22	1,900	1,060	20	34
3/22	1,976	1,060	20	34
3/22	1,714	1,060	20	34
3/23	2,181	668	7	44
4/11	2,829	2,154	5	62
4/12	2,319	2,154	18	64
4/12	2,000	2,154	18	64
4/12	2,713	2,154	18	64
4/13	1,467	2,154	14	65
4/13	2,360	2,154	14	65
4/14	1,930	2,154	6	65
4/14	2,193	2,154	6	65
4/14	2,562	2,154	6	65

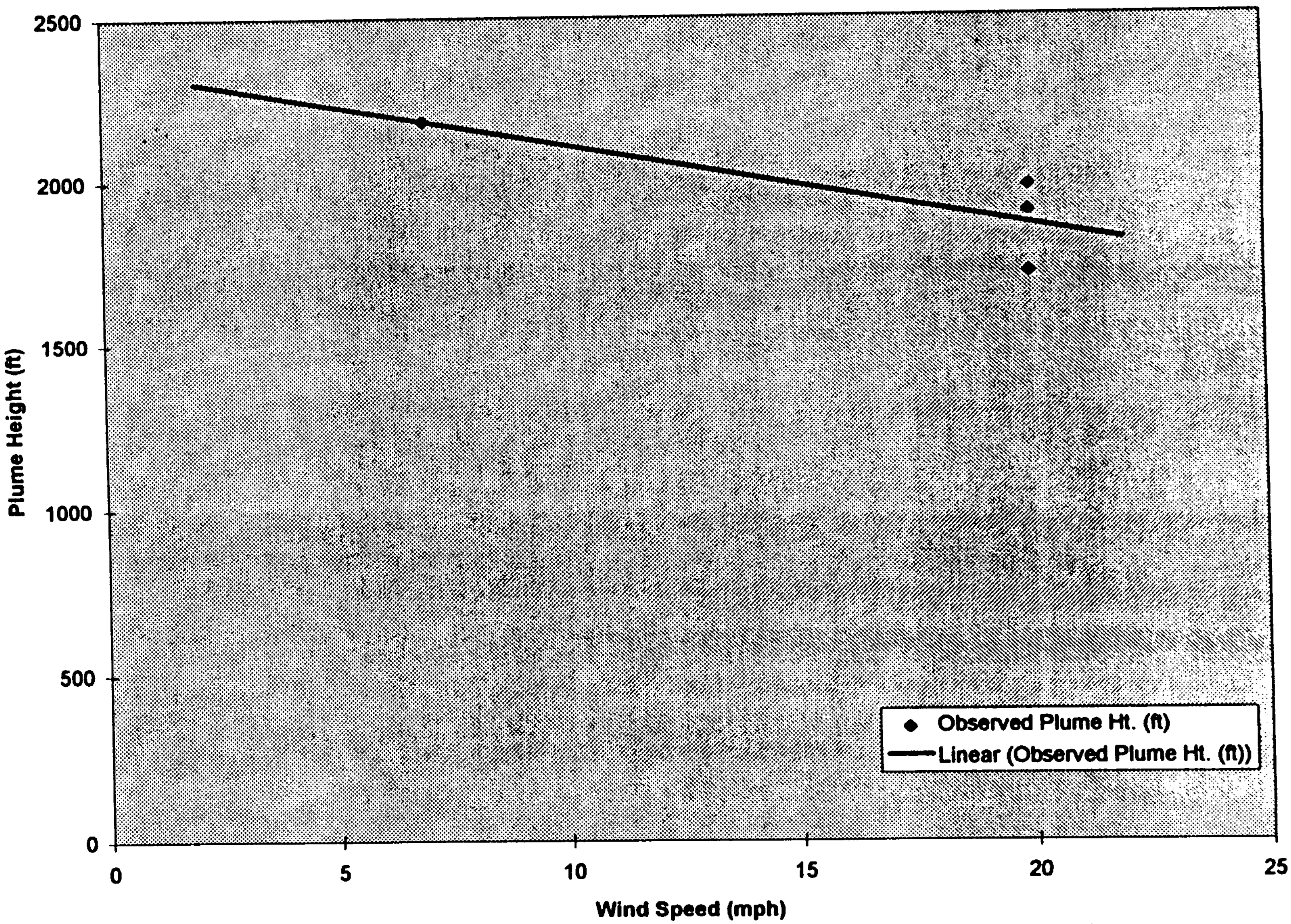


Figure 1. Open detonation observed effective plume heights versus observed 10-meter wind speed for 1,000 lb treatment events.

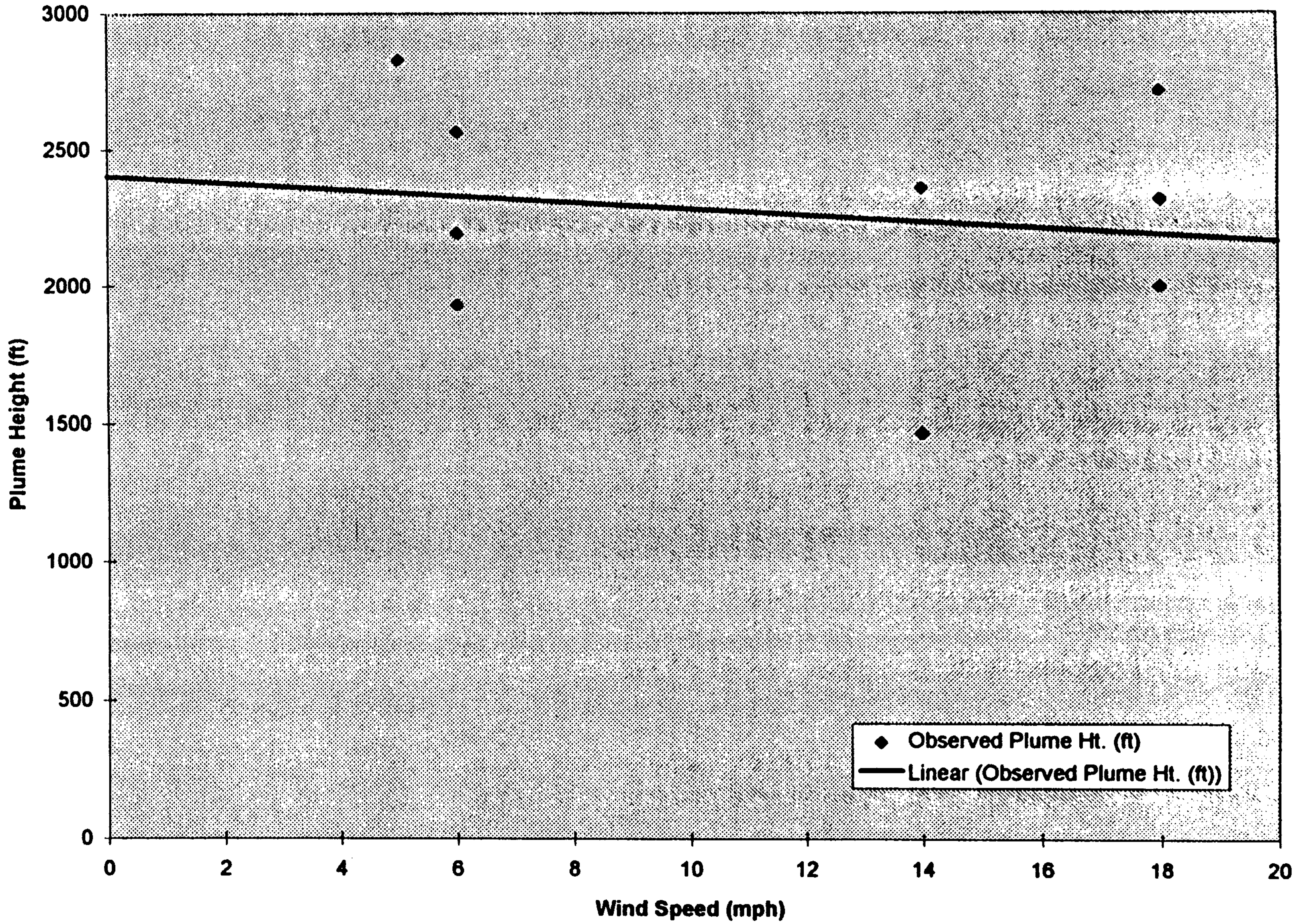


Figure 2. Open detonation observed effective plume heights versus observed 10-meter wind speed for 2,000 lb treatment events.

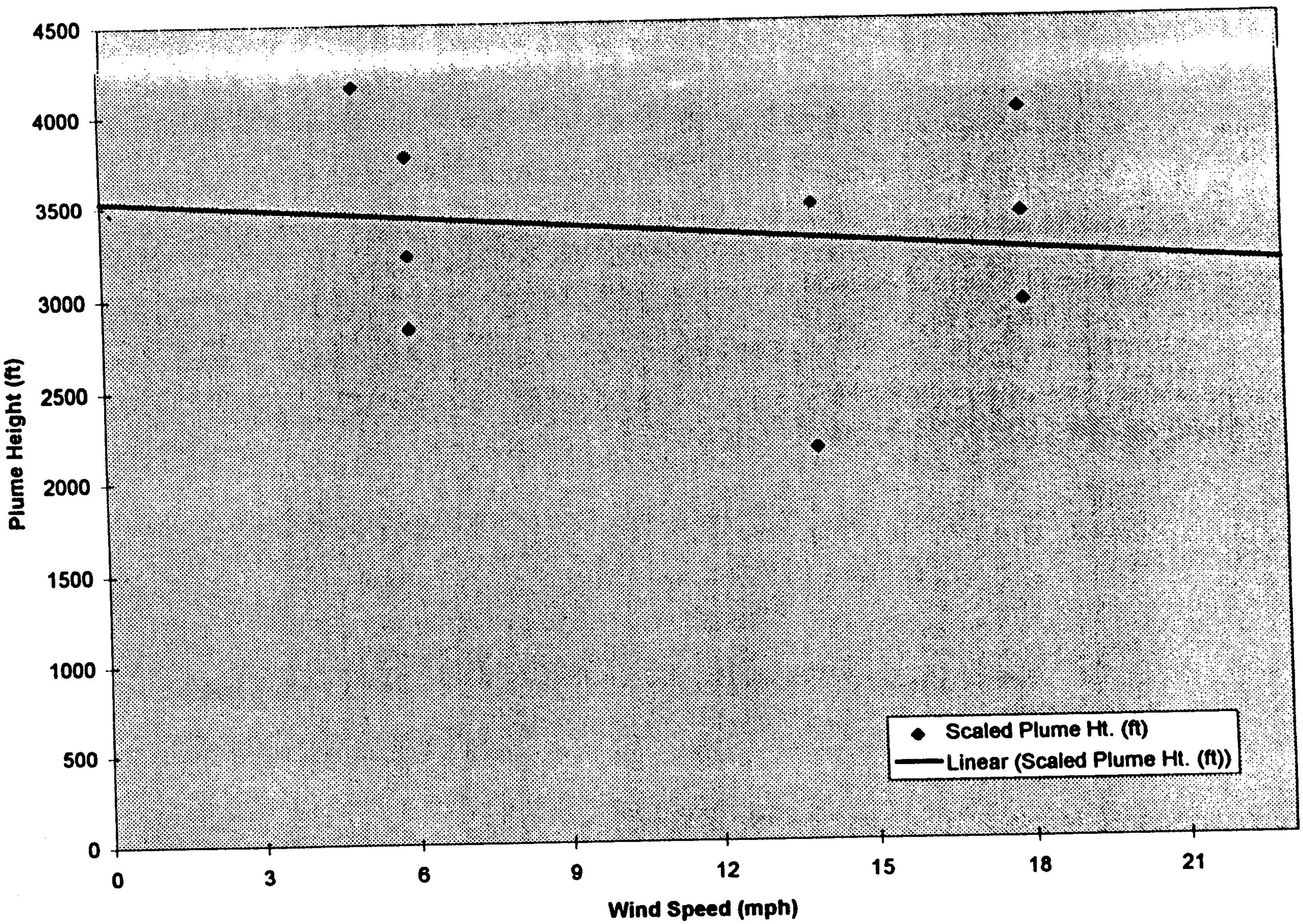


Figure 3. Open detonation scaled effective plume heights versus observed 10-meter wind speed for 10,000 lb treatment events.

APPENDIX G

SECTION 7.0 SUPPORT MATERIAL

APPENDIX G

RESERVED FOR POTENTIAL FUTURE USE